

Prof. Andriy Bogucki
Ivan Franko National University of Lviv
41, Doroshenko St.
79007 Lviv, Ukraine
e-mail: andriy.bogucki@lnu.edu.ua

Review

**of the professional accomplishments of Jarosław Waroszewski, Ph.D.,
entitled "Stratigraphy, provenance and role of thin loess deposits and loess
contribution in evolution of soils in the south-western Poland" for the conferment
of the post-doctoral degree of doctor habilitated in the field of Natural sciences,
in the discipline of Earth and Environmental sciences**

A formal basis for the review

The assessment of the professional accomplishments of Jarosław Waroszewski was executed based on the decision of the Council of Scientific Disciplines of Earth and Environmental Sciences and Social and Economic Geography and Spatial Management of the University of Wrocław on November 19, 2021, and January 21, 2022 (letters DWNZKŚ.432.3.2021.AK, DWNZKŚ.432.2.2022.AG).

Material of the review

The review was prepared based on the submitted materials in electronic form, which are part of the application for granting Jarosław Waroszewski, Ph.D., of the postdoctoral degree of doctor habilitated in the field of Natural sciences, in the discipline of Earth and Environmental Sciences. They include:

1. PhD diploma in agriculture sciences (Attachment 1)
2. Applicant's data (Attachment 2)
3. Summary of professional accomplishments (Attachment 3)
4. List of scientific publications forming a scientific achievement (Attachment 3.A1–A4)
5. Confirmation of scientific activities with foreign institutions (Attachment 3.B1–B4)
6. List of scientific or artistic achievements which present a major contribution to the development of a specific discipline (Attachment 4)

7. Declaration of authors contribution to scientific articles forming a scientific achievement (Attachment 5.a–d)

Evaluation of scientific achievement

Ph.D. Jarosław Waroszewski is a renowned researcher in the field of Earth and Environmental Sciences. He is the author of 22 peer-reviewed journal articles, 7 chapters in monographs, editor of 3 monographs, manager of 3 and executor of 6 scientific projects. The H-index ranking according to the WoS Core Collection database is 15, the total impact factor is 74,127, and the total point according to MNiSW is 1700. Also, the habilitant reviewed 21 scientific articles.

Habilitation thesis, which is the result of the scientific activity of Ph.D. Jarosław Waroszewski, consists of a series of four thematically connected scientific articles under the common title "Stratigraphy, provenance and role of thin loess deposits and loess contribution in evolution of soils in the south-western Poland".

The scientific achievement being the basis for applying for the habilitation degree is a series of four original scientific publications published between 2018 and 2021. In the articles included in the series, the habilitant is the leading author of all four co-authored works. The total Impact factor (IF) for the entire publication cycle is 15.647, and the total number of points according to the Ministry of Science and Higher Education in Poland (scored in the years of publication) is 515 points. A detailed analysis of the contribution of the habilitant is given below.

1. Waroszewski J., Pietranik A., Sprafke T., Kabala C. Frechen M., Jary Z., Kot A., Tsukamoto S., Meyer-Heintze S., Krawczyk M., Labaz B., Schultz B., Erban Kochergina Y.V., 2021. Provenance and paleoenvironmental context of the Late Pleistocene thin aeolian silt mantles in south-west Poland – a widespread parent material for soils, Catena 204, 105377. doi.org/10.1016/j.catena.2021.105377; 140 pt. (IF₂₀₂₀ – 4.333)

The work is dedicated to the origin and paleoecological analysis of the thin aeolian silt mantles of south-west Poland as parent material for soils. We agree with the main conclusion of the work. At the same time, we emphasize the widespread use of data from mineralogical and isotopic analyzes by the habilitant. J. Waroszewski stands on the position of the aeolian origin of the loess and connects the time of its formation in Southwestern Poland with the Last Glacial Maximum (LGM), which we cannot deny. The author's data on the mixed (local Sudetic – meandering valley of the Odra River, and Scandinavian – glacial complex) origin of the silt material are important. This research

highlights the role of the (Pleistocene) Great Odra Valley in collecting and homogenizing materials, while supplying the region with fine particles to be deflated by paleowinds from open surfaces.

2. Waroszewski J., Sprafke T., Kabala C., Muszyńska E., Kot A., Tsukamoto S., Frechen M., 2020. Chronostratigraphy of silt-dominated Pleistocene periglacial slope deposits on Mt. Ślęza (SW, Poland): palaeoenvironmental and pedogenic significance. *Catena* 190, 104549. doi.org/10.1016/j.catena.2020.104549; **140 pt. (IF₂₀₂₀ – 4.333)**

Although Polish science has made significant achievements in the study of periglacial slope deposits since the time of Prof. Jan Dylík, there are many complex and unresolved problems in the study of periglacial slopes. The concept of periglacial cover beds differentiates slope deposits with or without aeolian silt admixture, yet there is a remaining debate on processes and the timing of their formation. J. Waroszewski consider some of these issues in his habilitation thesis. The author earlier concluded that slope deposits with variable aeolian silt admixture, or its lack, have a significant influence on the pathway of soil formation. The present work built upon this finding by adding further granulometric and micromorphological data from three representative profiles along a toposequence, in order to refine the author's understanding of local slope deposits and soil formation. Additionally, seven numerical ages using luminescence dating provided a chronological framework for the reconstructions and allowed the author to link the forming processes of these pedosedimentary records to regional palaeoenvironmental conditions. We would like to emphasize the use of micromorphological and isotopic data by the habilitant, as well as a large amount of involved factual material.

3. Waroszewski J., Sprafke T., Kabala C., Kobierski M., Kierczak J., Muszyńska E., Loba A., Mazurek R., Łabaz B., 2019. Tracking textural, mineralogical and geochemical signatures in soils developed from basalt-derived materials covered with loess sediments (SW Poland). *Geoderma* 337, 983-997; doi.org/10.1016/j.geoderma.2018.11.008; **200 pt. (IF₂₀₁₉ – 4.848)**

Textural, mineralogical and geochemical features of soils formed on a complex parent substrate are very important. It is a local basalt-derived substrate and loess mantle. Based on the field description, particle size distribution, mineralogy (heavy minerals and clay minerals) as well as geochemistry the author tracked the signal of both materials (local basalt-derived and loess-derived), estimated the maximum thickness of loess mantles and mixed zones (having both loess and basaltic components), and noted the presence or absence of basal layers without allochthonous additions. The results showed that geochemistry and heavy minerals are the most reliable proxies for

verification of aeolian silt contributions and to define individual layers in complex soil parent materials. It is also concluded that at the edge of thin loess deposits no soils exist that developed exclusively from basaltic parent materials. This requires a mixed basalt-derived and loess-derived substrate.

4. Waroszewski J., Sprafke T., Kabala C., Musztyfaga E., Labaz B., Wozniczka P., 2018. Aeolian silt contribution to soils on the mountain slopes (Mt. Ślęza, SW Poland). Quaternary Research 89(3), 702-717. doi.org/10.1017/qua.2017.76; 35 pt. (IF₂₀₁₈ – 2.310)

The last one of a series of four thematically connected scientific articles from J. Waroszewski's professional accomplishments evaluates the possible contribution of aeolian silt to the soils of Mt. Ślęza in southwest Poland. Silt loam textures are common across Lower Silesia and are often confused with silt clay loam, especially at the outer boundaries with thin loess deposits. The article presents the results of the field study of soils in eight study sites with different thicknesses of silt loam mantles that are covered and/or mixed with underlying sediments. The comprehensive use of geochemical and mineralogical methods in this research has made it possible to verify the relationship between loess and underlying material, identify mixing zones and define soil types. Concentrations of major and trace elements as well as their cross ratios allowed the author to confirm the aeolian origin of silt loam materials and clearly distinguished them from basal sediments. The research of the habilitant showed a clear relationship between the presence and depth of aeolian mantles and mixing zones with the type of underlying material.

Below we will consider some aspects of research that are defended.

Introduction and purpose of research

There is no doubt that loesses are one of the most characteristic and widespread genetic types of continental sediments on the planet. A large number of scientific works are devoted to various aspects of loess issues. But it is worth emphasizing that in various regions these issues are different. Thick (up to 50 m) loess deposits cover over 70% of the territory of Ukraine. I work mainly on the Volhyn-Podolian Upland, where an almost continuous loess cover with an average thickness of 20-30 m and more is developed. We do not have the problem of a thin loess mantle, there are almost no crystalline rocks with developed eluvium strata. But we understand the problems that the habilitant solves, we evaluate them positively and agree with the conclusions that weathered strata of crystalline rocks do not play a role as independent parent material of soils of southwestern

Poland. In most cases, they are enriched with aeolian silt. Therefore, there is a question of identification and assessment of the degree of aeolian silt admixtures in the soils of southwest Poland, as well as the diagnosis of soil transformation due to these admixtures. There is also the question of defining geochemical and mineralogical markers for the establishment of aeolian admixtures. The habilitation thesis of Jarosław Waroszewski is devoted to these difficult issues.

Study area and methodology

Southwestern Poland (Lower Silesia, the Opole Region) was selected as the study area. This is a vast region, which allowed choosing different types of relief and areas with diverse geological structure. Transects for research were selected successfully. It is important that they also cover different types of weathered strata (serpentinites, gabbro, basalts, glacial tills, fluvioglacial materials covered with a layer of aeolian silt, etc.).

The number of methods and laboratory analyses used by the habilitant to substantiate the main principles of work is impressive. These are both general and specialized methods, including micromorphological, mineralogical (including the study of the composition of the clay fraction), analysis of heavy minerals, etc.

Provenance of thin loess deposits and the paleoenvironment

An important aspect of the research was to determine the provenance of the aeolian silt forming thin loess deposits and contributing to soils as an admixture. So far, in Southwestern Poland, the origin of the fine-grained silt material has been traced to the Great Odra Valley, which, together with tributaries from the Sudetes, supplied the region with silt from the mountains and the Fennoscandian ice sheet. Wind-blown silt was deposited along the south and southeast directions and formed a wide loess belt. However, with regard to the thick and thin loess deposits, no determination has been made as to whether the Sudeten or Scandinavian source is the dominant one.

The presented in the habilitation thesis conclusions clearly emphasize the role of the Odra river valley and its tributaries in supplying the entire region with homogenized silt material from the Sudetes and Fennoscandian ice sheet lithologies, which then blows out from dried riverbanks and river terraces. This loess distribution model is also supported by the grain size analysis, which indicates decreasing grain sizes towards the south. The significant share of Scandinavian material in the thin loess deposits suggests not only a direct supply from the Fennoscandian ice sheet but also silt from weathering and the redeposition of older glacial and fluvioglacial sediments. The obtained results give rise to the assumption that a number of isotopic and mineralogical differentiations (including in the hornblende populations), especially for objects located closer to the

Sudetes, are associated with very local sources, i.e., primarily smaller river valleys as well as the short-distance blowing of aeolian silt.

The habilitant conducted a set of mineralogical and geochemical studies, which showed that the silt material is mixed and it is difficult to establish the superiority of the Sudeten or Scandinavian source of the material. Note that the role of the Scandinavian source of silt material is estimated at approximately 30-50%.

Detection of aeolian silt and tracking loess signatures in soils

An important aspect of the research achievement was the identification of the admixture of aeolian silt (or the lack thereof) as well as the scale of this mixing, both in terms of the soil and various geological substrates. J. Waroszewski selected a number of methods for the detection of the aeolian component that ranged from the field identification of silt particle sizes to laboratory analyses of soil texture, the application of geochemical and mineralogical tools (heavy minerals as well as clay mineralogy) and the compilation of these results in a matrix. Geochemistry turned out to be the most precise tool for identifying admixtures of aeolian silt. The habilitant highlights the importance of the proper evaluation of the vertical extent of mixing processes in soil profiles. An important aspect of this conclusion is that proper assessments should be made of the homogeneity of the substrates used in various scientific research projects, especially for projects related to the mobility and bioavailability of trace elements.

Admixtures of loess vs. the morphology and pathways for soil development

It is worth agreeing with the habilitant that the scale at which loess mixes with local rocks depends primarily on the structure of the material onto which the loess was directly deposited. In the case of coarse-grained granite regoliths and basalt covers, aeolian silt penetrated deeply, and in the case of underlying fine-grained and dense serpentine slope deposits or fluvio-glacial materials, it was deposited on their surface. This had a great influence on soil development, determining the direction of soil formation, in particular the development of illuvial processes. We would like to emphasize the practical significance of this conclusion.

Also, we would like to add that the work would be very beneficial if the schemes of the structure of weathered strata on different rocks were added to it. This would make the material easier to understand. Jarosław Waroszewski also emphasized the role of erosion processes, redeposition processes in soil development and the formation of their properties.

The age of a thin loess deposit vs. pedogenesis

An important achievement of the habilitation work is the dating by TL and OSL methods of slope sediments with a distinct admixture of aeolian silt. In most cases, these dates are in the range of 17.7–23.0 ka yr. (MIS 2) and correspond to the time of maximum loess accumulation in southwestern Poland, which is estimated at 20–25 ka yr. and correlates well with dating data of slope sediments with loess admixture in Western Europe. So, the obtained dates are very valuable due to the possibility of linking the timeframes for slope cover formations with admixtures of aeolian silt with their analogues from Western Europe.

It is worth noting that the evaluation of the conclusions of the work is very lacking in detailed data on the age of the soils of southwestern Poland.

The comments and suggestions for the work of J. Waroszewski expressed in the text of the review do not affect the quality of the research and should be considered as recommendations for further research.

We would like to emphasize the most important scientific achievements of the habilitant:

- Clarification of the provenance of aeolian silt forming thin loess deposits and forms admixtures to the soil, as well as an attempt to model the sources of its provenance.
- The development of a soil evolution model that depends on the scale of aeolian silt mixing in various parent substrates.
- Chronostratigraphy of the slope deposits containing significant admixtures of aeolian silt, as these had not previously been dated in Poland with the optically stimulated luminescence method.

Assessments of other scientific, teaching and organizational achievements

Jarosław Waroszewski has been actively involved in research at a number of foreign research and educational institutions. This includes research internships, development of common research projects, common fieldwork, training of scientific personnel, preparation of common scientific publications and participation in international conferences.

The international activity of the habilitant is indisputable. Here are the main institutions which Jarosław Waroszewski cooperates with:

- University of Innsbruck
- University of Zurich

- University of Bern
- Leibniz Institute of Applied Geophysics in Hanover.

As a result of scientific cooperation, the habilitant has published 17 scientific papers, mostly in high-ranking peer-reviewed journals included in scientometric databases.

Jarosław Waroszewski has significant achievements in the field of didactics. He lectures and conducts laboratory classes in a number of courses at the Wrocław University of Environmental and Life Sciences, in particular, reclamation of geomechanically transformed soils (leader), environmental impact assessment, environmental risk management, soil resources, soil science and soil valorization, natural resources, comprehensive field exercises, geology with elements of geomorphology. For foreign students of the ERASMUS+ program, he has conducted the following courses in English: soil science and environmental risk assessment. Also, he supervised five master's theses in the field of environmental protection and five engineering theses (environmental protection, management and production). As the result of habilitant scientific cooperation with Swiss universities, he co-promoted a Ph.D. thesis of Martina Vöggtli at the University of Zurich and has been involved as an expert in a master's thesis of Rea Keller at the University of Bern.

Jarosław Waroszewski has many organisational achievements and popularizing science and art. First of all, this is participation in the Research Student Scientific Group for Soil Science and Environmental Protection, where he has been one of the two supervisors of this group since 2014, as well as co-establishing the Micromorphology Laboratory at the Institute of Soil Science and Environmental Protection (WUELS).

Jarosław Waroszewski has also been involved in the organization of two international scientific conferences, and as a guide in conducting a number of workshops for youth from secondary schools. The habilitant has been a principal investigator for three research projects and a co-investigator for another six ones. He is also a co-supervisor for two doctoral theses.

During his research and teaching career, Jarosław Waroszewski has received a number of awards.

Conclusions

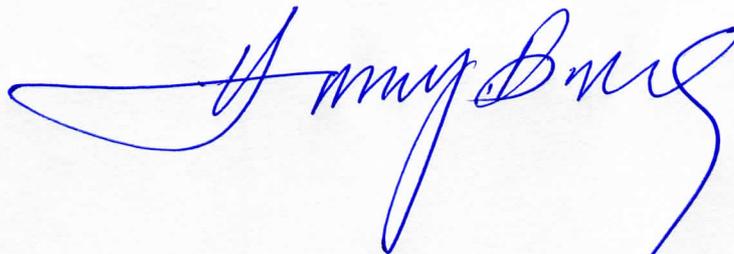
Reviewed habilitation thesis of Jarosław Waroszewski, Ph.D., is a very relevant and serious contribution to soils and loess issues.

The presented research work reveals the role of aeolian silt in soil formation, formation of soil properties and their evolution. Analysis of the scientific achievements of

J. Waroszewski shows that he is a very active researcher who has found topical research issues and is actively developing them. The work of the habilitant is based on substantial modern material of the laboratory analyses, especially mineralogical and geochemical. The research results are widely published. The habilitant is involved in many scientific projects, including international ones.

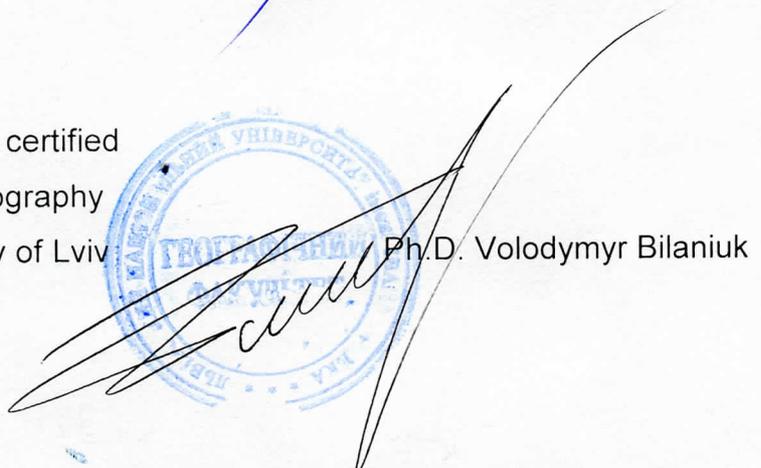
Habilitation thesis of Jarosław Waroszewski "Stratigraphy, provenance and role of thin loess deposits and loess contribution in evolution of soils in the south-western Poland" I rate unequivocally positively. The scientific achievements of the habilitant fully meet the requirements specified in Art. 219 paragraph. 1 point 2 and 3 of the Act of July 20, 2018 Law on Higher Education and Science (Journal of Laws of 2020, item 85, as amended), taking into account Art. 179 paragraph. 6 of the Act of July 3, 2018 Introducing the Act - Law on Higher Education and Science (Journal of Laws of 2018, item 1669, as amended).

In this regard, I send this positive review to the Habilitation Committee in order to continue the habilitation procedure. **I support the professional accomplishments of Jarosław Waroszewski, Ph.D., entitled "Stratigraphy, provenance and role of thin loess deposits and loess contribution in evolution of soils in the south-western Poland" for the conferment of the post-doctoral degree of doctor habilitated in the field of Natural sciences, in the discipline of Earth and Environmental sciences.**



Prof. Andriy Bogucki

Signature of Prof. Andriy Bogucki certified
by the Dean of the Faculty of Geography
of Ivan Franko National University of Lviv



Ph.D. Volodymyr Bilaniuk