Załącznik 4

Dr Piotr Szwarczewski

AUTHOR'S SUMMARY PRESENTING A SERIES OF THEMATICALLY ASSOCIATED PUBLICATIONS AND OTHER RESEARCH ACHIEVEMENTS

Wydział Geografii i Studiów Regionalnych
Uniwersytet Warszawski
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Author's summary presenting

a series of thematically associated publications

and other research achievements

1. Name and Surname: Piotr Szwarczewski

2. Diplomas and academic degree

- Doctoral degree in Earth Sciences, field of study: geography. Faculty of Geography and Regional Studies, University of Warsaw, on 29th of June 1999;

  Title of PhD Thesis: Trace elements content in alluvial sediments as the indicator of river valley evolution.

- Master of Sciences in geography, specialty: physical geography; Faculty of Geography and Regional Studies, University of Warsaw, on 12th of January 1994.

3. History of employment

1.10.2013-today - senior lecturer at Faculty of Geography and Regional Studies, University of Warsaw (Department of Geomorphology/Laboratory of Environmental Analyses)

01.012.1999-30.09.2013 - adjunct at Faculty of Geography and Regional Studies, University of Warsaw (Laboratory of Sedimentology/Department of Geomorphology)

01.07.1999 – 30.11.1999 - assistant at Faculty of Geography and Regional Studies, University of Warsaw (Laboratory of Sedimentology)

01.03.1995 – 29.06.1999 - PhD student at Faculty of Geography and Regional Studies, University of Warsaw (Laboratory of Sedimentology)

18,04.1994-28.02.1995 - editor at Bulletin of The Polish Academy of Sciences (Earth Sciences series)

4. Main scientific achievement

As an academic achievement in relation to Art. 16 (2) of the Act of March 14, 2003, on Academic Degrees and Academic Title, and Degrees and Title in Art (Official Journal Dz. U. No. 65, item 595, as amended), I hereby indicate a series of eleven thematically associated publications.

The series of eleven thematically associated publications is entitled:

Variation of lithologic-geochemical record of human activity on selected examples from Poland and Lithuania

The list of publications consisting the main scientific achievement as a basis for the application for the degree of habilitated doctor:

publication 1 [1]
Szwarczewski P., 2003, Record of natural and anthropogenic changes of the natural environment in the vicinity of Żyrardów on the example of sediments filling the mill pond (Zapis naturalnych i antropogenicznych zmian środowiska przyrodniczego w okolicach Żyrardowa na przykładzie osadów wypełniających nieckę stawu młyńskiego). [w:] Man in the natural environment - record of the activity (Człowiek w środowisku przyrodniczym - zapis działalności), Waga J.M., Kocel K. (red.), PTG Sosnowiec, ss. 213-219.
Points of Polish Ministry of Science and Higher Education (Pts of PMSHE) **- 4**

publication 2 [2]
Szwarczewski P., 2005, Geochemical and paleogeographic record of the dynamics of geomorphic processes in the Holocene on the example of slopes near Płock (Geochemiczny i paleogeograficzny zapis dynamiki procesów rzeźbotwórczych w holocenie na przykładzie stoków w okolicach Płocka), [w:] The problems of functioning of lowland landscapes (Z problematyki funkcjonowania krajobrazów nizinnych) Richling A., Lechnio J. (red.), Wyd. WGiSR UW, Warszawa, 77-88.
Pts of PMSHE **- 4**

publication 3 [3]
Szwarczewski P., 2007, Stages of cutting the Ursynów Scarp (Skarpa Ursynowska, Warsaw), (Etapy rozcinania Skarpy Ursynowskiej, Warszawa), Prace Instytutu Geografii AŚ w Kielcach (Works of the Institute of Geography, Kielce), 16, 157-171.
Pts of PMSHE **- 0**

publication 4 [4]
Błoński M., **Szwarczewski P.**, 2008, Anthropogenic transformation of the Nasielna river valley in the vicinity of the early medieval stronghold in Nasielsk (Antropogeniczne przekształcenia doliny Nasielnej w sąsiedztwie wczesnośredniowiecznego grodziska w Nasielsku), Archeologia Polski, t. LIII, z. 2, 291-317.
Pts of PMSHE - **6 (C)**
My contribution to the creation of this work consisted in preparing the concept of environmental research, participation in field work (together with M. Błoński), drilling, preparation of parts of illustrations (authorship of individual drawings included in the above work) and preparation of the text in the part related to environmental issues. I estimate my contribution to 50%.

publication 5 [5]
Szwarczewski P., 2009, The formation of deluvial and aluvial cones as a consequence of human settlement on loess plateau: an example from the Chroberz area (Poland). *Radiocarbon*, 51, 2, 445-455,
https://doi.org/10.1017/S0033822200055843
Pts of PMSHE - **32 (A,** abstracted in **WoS)**, IF - 1,67, 5 year IF - 1,744

publication 6 [6]
Szwarczewski P., 2009, Influence of settling Masovia (from the Middle Ages to modern times) on geomorphological forms and processes on the example of the valley of the Lower Świder (Wpływ zasiedlenia Mazowsza (od średniowiecza po czasy współczesne) na formy i procesy geomorfologiczne na przykładzie doliny dolnego Świdra). [w:] Domańska L., Kittel, P., Forysiak, J. (eds.). Environmental conditions of the settlement's location (Środowiskowe uwarunkowania lokalizacji osadnictwa), 347-353.
Pts of PMSHE **- 4**

publication 7 [7]
Stančikaitė M., Bliujienė A., Kisielienė D., Mažeika J., Taraškevičius R., Messal S., **Szwarczewski P**., Kusiak J., Stakėnienė R., 2013, Population history and palaeoenvironment in the Skomantai archaeological site, West Lithuania: Two thousand years, Quaternary International, Volumes 308–309, 190–204.
IF - 1,962 (5 lat 2,150)
Pts of PMSHE - **30 (A,** abstracted in **WoS)**, IF - 2,128, 5 year IF - 2,446
My contribution to the creation of this work consisted in participation in field research, geological drilling and sampling of some sedimentological and geochemical analyzes, making selected drawings (Figures 2 and 5), highlighting the phases of anthropopressure based on lithologic and geochemical features and authorship regarding the above issues. I estimate my percentage share at 20%.

publication 8 [8]
Szwarczewski P., Smolska E., 2013, Geochemical features of slope and fluvial sediments in north-western Mazovia (Cechy geochemiczne osadów stokowych i fluwialnych na północno-zachodnim Mazowszu), Studies in Geography (Prace i Studia Geograficzne), t. 51, 105-123.
Pts of PMSHE **- 3 (B)**
My contribution to the creation of this work consisted in participation in field research (work was conducted jointly with E. Smolska), geological drilling, sampling and physicochemical analyzes of sediments. The illustrations prepared, the interpretation of the results obtained and the text are the result of the joint work of the authors. I estimate my contribution to 50%.

publication 9 [9]
Smolska E., **Szwarczewski P.**, 2014, Landscape changes based on sedimentological and geochemical studies in the region of Brudzeń Duży, Miscellanea Geographica, Vol. 18, No. 1, 52-60.
Pts of PMSHE **- 9 (B)**
My contribution to the creation of this work consisted in participation in field research (work was conducted jointly with E. Smolska), geological drilling, sampling and physicochemical analyzes of sediments. The illustrations prepared, the interpretation of the results obtained and the text are the result of the joint work of the authors. I estimate my contribution to 50%.

publication 10 [10]
Smolska E., **Szwarczewski P.**, 2016, Zagłębienia jako geoarchiwa i ich wykorzystanie w badaniach antropopresji na przykładzie okolic Góry Grodzisko koło Skomacka Wielkiego na Pojezierzu Ełckim (Hollows as geoarchives and their uses in the study of human impact on the environment - the case study of Góra Grodzisko (Hilfort Hill) at Skomack Wielki in Ełk Lake District), [w:] Archeologia Jaćwieży. Dawne badania i nowe perspektywy (Yatving Archaeology. Past Research, New Perspectives), Bitner-Wróblewska A., Brzeziński W., Kasprzycka M. (red.), PMA, Stowarzyszenie Starożytników, Warszawa, 159-175.
Pts of PMSHE **- 5**
My contribution to the creation of this work consisted in participation in field research (work was conducted jointly with E. Smolska), geological drilling, sampling and physicochemical analyzes of sediments. The illustrations prepared, the interpretation of the results obtained and the text are the result of the joint work of the authors. I estimate my contribution to 50%.

publication 11 [11]
Król E., **Szwarczewski P.,** 2018, Magnetic susceptibility of sediments as an indicator of the dynamics of geomorphological processes [in:] Magnetometry in Environmental Sciences, Springer, Cham, 79-89.
Pts of PMSHE - **10 (**abstracted in **WoS)**
My contribution to the creation of this work consisted in performing all field research, taking the samples, preparing samples for analysis, interpretation of results, execution of all drawings and co-authorship of the text. I estimate my contribution to 50%.

Variation of lithologic and geochemical record of human activity on selected examples from Poland and Lithuania

The publications consisting the main scientific achievement relate to research conducted in areas of various geological structure, geomorphology, but first of all, of various history of settlement and economic development (eg Kaczanowski, Kozłowski 1998). From very attractive loess areas inhabited and often used agriculturally without long breaks (Szwarczewski 2009 [5], Król, Szwarczewski 2018 [11]), by old and young glacial areas of Mazovia already settled in the Neolithic and Bronze Age but above all from the early Middle Ages (Szwarczewski 2003 [1], 2005 [2], 2007 [3], 2009 [6], Błoński, Szwarczewski 2008 [4], Szwarczewski, Smolska 2013 [8], Smolska, Szwarczewski 2014 [9]), to the young glacial landscapes of Eastern Poland and Northern Lithuania, where relatively simple forms of economic activity persisted for a long time and anthropopression was mainly local (Stančikaitė and others 2013 [7], Smolska, Szwarczewski 2016 [10]). The diversity of environmental conditions and prehistorical and historical economic activity of people in selected areas is presented in a synthetic way in Figs 1-3.

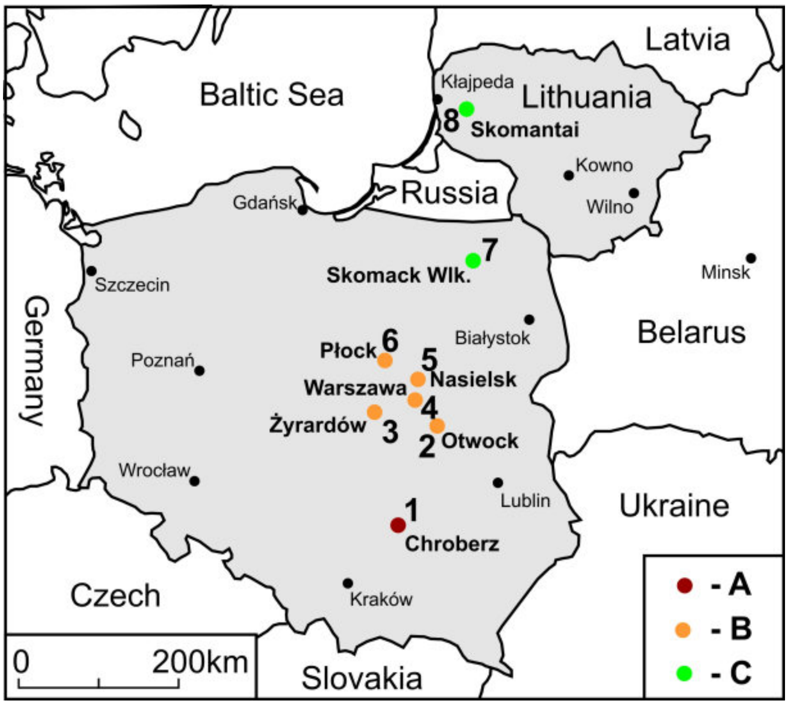

Fig. 1. Location of test sites.
A - loess highlands of southern Poland, B - Old and young-glacial areas of Mazovia, C - Lakelands and uplands within the Baltic settlement.

The research issues I would like to present as part of the scientific achievement include the following main problems: (1) spatial differentiation of the economic record of human activity in the natural environment and its conditions on the example of selected sites from Poland and Lithuania and (2) Vertical lithological-geochemical variability of sediments and its significance in the reconstruction of phases of human economic activity in the past.

Introduction

The reaction of the natural environment to climate change and progressive anthropopressure and its record depends very much on local conditions such as geological structure (and lithology), geomorphology, soil diversity, hydrological conditions, flora and fauna. Large spatial differentiation of geomorphology and lithology in the hilly landscapes of the post-glacial areas contributes to the locally variable record, whereas landscapes of loessic plateaus with little divesified lithology, made of deposits very susceptible to erosion, promote denudation and erosion processes, which often leads to fragmentation and segmentation of morphological units. It especially leads to large erosion and outflow of sediment from the basin to the bottom of valleys and depressions (np. Kosmowska-Sufczyńska 1983, Starkel 2005, Smolska 2005, Goudie 2006, Williams 2006, Twardy 2008).

The main lithological reaction to changes in land use or climatic conditions is the difference in the formation of sediments (change, often visible, in type of sedimentation). The "sharp" boundaries in the formation of sediments are the record of this. Deforestation and occupancy of subsequent areas for agricultural activity is conducive to erosion processes and acceleration of denudation, especially in areas with varied morphology and built of susceptible deposits for erosion (Sinkiewicz 1998, Goudie 2006, Williams 2006, Twardy 2008). The bases of the slopes and local depressions are covered by deluvial and proluvial sediments, and the slopes dissect the furrows, which together with the intensification of agricultural use can transform into gullies. The wet climate phases are conducive to the intensification of erosional processes, and in the bottoms of hollows and valleys having problems with water drainage, they may lead to local peat deposition (np. Starkel 1988, 2001, 2005, Klimek i in. 2003).

Geochemical characteristics of sediments can be a source of information about the local and regional diversification of economic activity in the past. Initially, this impact and geochemical record were of local nature (e.g. the Bronze and Iron Age) and were associated with the functioning of small workshops or their groups. With the increase in population and industrial development (especially since the industrial revolution), changes in the chemistry of sediments caused by anthropopressure have been observed in larger areas, and air and water pollution is of a regional or global nature.

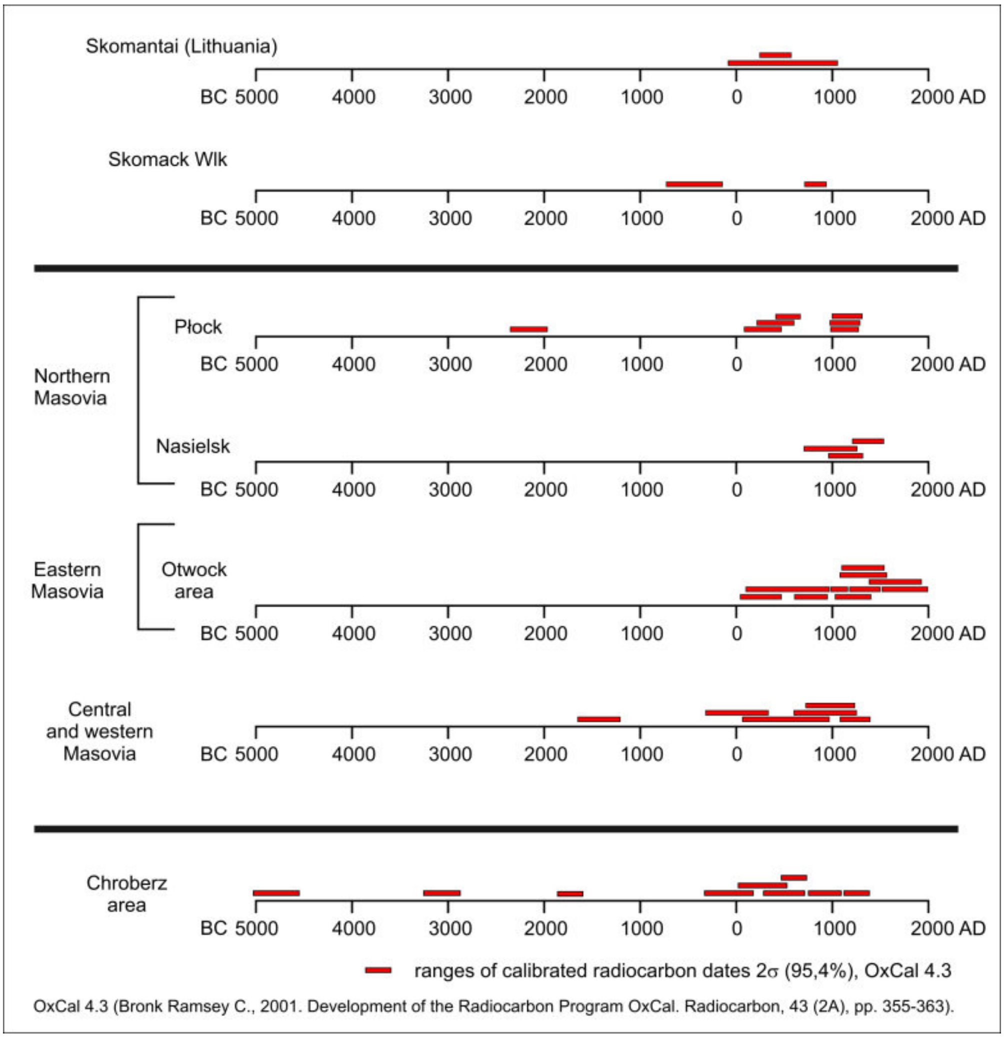

Fig. 2. List of results of radiocarbon dating documenting the reactions of the natural environment to the next phases of population settlement.
(Dates come from research sites included in the main scientific achievement).
Groupings of dates indicate differences in the history of settlement of the studied areas resulting in part from different environmental conditions - for example, better and easier areas for cultivating soils found on loess (near Chrobrza) and Równina Łowicko-Błońska (Central and Western Mazovia).

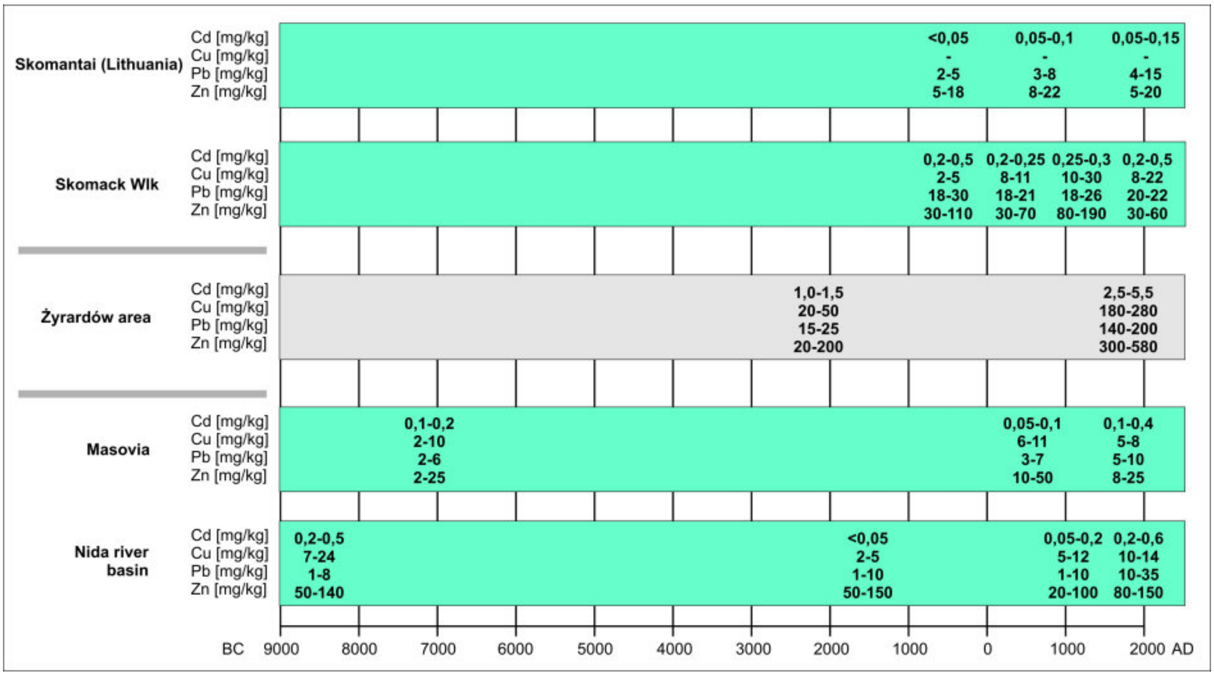

Fig. 3. List of minimum and maximum contents of selected trace elements from research sites included in the main scientific achievement.

The content of heavy metals does not give direct information about the age of sediments but their vertical variability together with radiocarbon-dated organic levels (fossil soils, peat) allows to correlate levels of increased concentration of metals such as Pb, Zn, Cd or Cu with phases of human economic activity in the studied area in the prehistoric period or historical times. The concentration of heavy metals in sediments depends on many factors, including local geochemical background (natural concentrations of studied elements), mechanical composition (share of fine silt and clay fraction), organic matter content, carbonates, oxides and hydroxides of iron and manganese, pH or redox (np. Bojakowska 1994, 1995, Kabata-Pendias, Pendias 1999, Ciszewski 1998, Ciszewski i in. 2003, Zgłobicki 2008).

Magnetic susceptibility of sediment is also a very good indicator of anthropopressure in sediments. Its measured value depends, among others on the mineral composition of the studied sediments (presence of ferromagnetic components), but also on the economic activity of man - the supply of heavy metals associated with the economic activity of man and magnetic particles arising from the burning of minerals and wood (np. Chan i in. 1998, Georgeaud i in, 1997, Zhang i in. 2011, Król, Szwarczewski 2018 [11]).

Separation of natural processes related to climate change from anthropogenically initiated is very difficult, requires the use of interdisciplinary research (including geological, geomorphological, sedimentological, geochemical, analysis of available historical sources, archaeological materials and historical and modern topographic maps).

The obtained results of palaeoenvironmental studies were correlated with available archaeological knowledge (results of the neighborhood of archaeological research or data of the Archaeological Picture of Poland) and the historical one.

Loessic plateaus of the southern Poland e.g. Ponidzie Pińczowskie region (Wodzisław Hummock and Nida river valley area)

Interdisciplinary research carried out in the area of Chrobrza (Wodzisław Hummock, Ponidzie Pińczowskie, fig. 1. - site 1) showed a multi-stage reaction of the loess plateau to the progressive anthropopressure (Szwarczewski 2009 [5], Król, Szwarczewski 2018 [11]).

The oldest recorded phase of economic human activity is related to the agricultural activity of the Neolithic population. The accumulation of deluvium on peat and peat mire in the Nida valley has already begun around 5890±100 BP (Linear Pottery Culture). They are one of the oldest absolutely dated deluvial sediments in Poland indicating changes in land use and the beginning of agricultural activity (Śnieszko, Grygierczyk 1991, Śnieszko 1995). Subsequent recorded stages of human economic activity are connected with the agricultural activity of the Funnel Beaker Culture (4420±100 BP) followed by the Bronze Age and the Iron Age (2150 ± 120 BP). In the Roman period (Przeworsk culture) in the studied area there occurs filling of of local karst (?) depression by deluvial (and alluvial) sediments. The elevation of the ground level gives the possibility of a continuous river outflow through the Mozgawka valley (previously the outflow was only underground, karstic). Filling of the depressions within the Wodzisław Hummock with sediments from the slope erosion makes possible the creatation and development of an alluvial-deluvial fan whose forehead moves in the bottom of the Nida valley by nearly 1 km in the period from 2150±120 BP to 1780±80 BP. From the early Middle Ages (1420±60 BP, 1440±100 BP) erosive processes on the loess slopes are so intense that in the areas of deluvial sediment accumulation I have studied were too short to develop the clear humus horizon. In the early Middle Ages, the next alluvial-deluvial fan begins to creatte and its forehead moves along the bottom of the Nida valley by about 1.5 km in the period between 1050±80 BP and 780±80 BP (Szwarczewski 2009 [5]). Radiocarbon dating allowed for calculation of the average rate of aggradation process. It was based on such data as: (a) thickness of deluvial deposits accumulated at the base of slopes, in the valley bottoms and depressions and (b) radiocarbon dating received and published in the works of Szwarczewski 2009 [5] and Król, Szwarczewski 2018 [11]. When the first farmers of neolithic cultures appeared, the rate of denudation processes was insignificant, with the development of agricultural activity the accumulation of deluvium at an average rate of 0.7 mm/year in the Neolithic period begins (accumulation about 180 cm of sediment in about 2,500 years), 0, 6 mm/year in the Bronze Age - early Middle Ages (accumulation of some 110 cm of deposits in about 1800 years) and at a rate of about 5 mm/year from the early Middle Ages (700 cm in approximately 1,400 years). High homogeneity and significant variability of measured magnetic susceptibility values in the upper two meter layer of sediments filling the bottom of the depression (see Figure 3 in the work of King, Szwarczewski 2018 [11]) allow to assume that they may be deposits accumulated in the last 100-200 years (from the beginning of the industrial revolution period), i.e. at an average rate of 10-20 mm/year - this is a rate similar to that known from the Czyżówka valley, i.e. 6 m deluvium-proluevial sediments from the fourteenth/fifteenth century (Kosmowska-Sufczyńska 1983).

The changes occurring under the influence of anthropopressure in the natural environment record in addition to the facial variability in the vertical variability of the content of trace elements such as Cd, Cu, Pb and Zn and magnetic susceptibility. Subsequent peaks of raised contents are already associated with economic human activity in prehistoric periods (listed and characterized above) and especially from the early Middle Ages, up to the present day.

The most important result of the research conducted in the area of the loess plateau and located in the vicinity of the Nida valley is the identification of significant morphological changes. The geological drilling and radiocarbon dating indicate more than 10 m of accumulation of deluvial sediments in the bottoms of valleys and depressions since the beginning of the settlement of the loessic plateau by the first farmers (Król, Szwarczewski 2018 [11], and also Szwarczewski 2009 [5]). This means that before the colonization of the studied areas by first farming cultures, the depressions were 10 m deeper and the tops of the plateaus were a bit higher, by several dozen cm to over a meter - this is indicated by the author's field observations and partially published research results (Moskal-del Hoyo and 2018). Archaeologists conducting research in the loess uplands, trying to reconstruct the natural environment and morphological conditions in prehistoric periods should take this factor into consideration. Larger denivelations probably influenced the availability of the studied area, the possibility of agricultural use but also the hydrological and microclimate conditions, the occurring vegetation and fauna. Deluvial deposits accumulated in bottom valleys since the end of the Atlantic period throughout the neo-Holocene most likely contain artifacts related to the activity of agricultural and metallurgical cultures and may become a subject of detailed palaeoenvironmental research in the future.

Old and young glacial areas of Masovia lowland

I want to present in the area of Mazovia, the variability of natural environment reactions to progressing anthropopressure on the example of research results from five areas: Żyrardów environs, Skarpa Ursynowska in Warsaw, the Świder river valley in the vicinity of Otwock, the Nasielna valley in Nasielsk and the Płock area (Figure 1 - sites 2-60). In individual research areas, diverse reactions of the natural environment to human economic activity were observed.

The oldest record of the natural environment reaction to economic human activity recognized by me is the level of charcoal (radiocarbon dated to 7090±100 BP) covered with a layer of sandy-silty deluvial sediments with a thickness of about 40-50 cm (Szwarczewski 2005 [2]). There are archaeological evidences of human presence in Neolithic period in the area of Mazovia (eg Bargieł, Zakościelna 2004), however, changes in the natural environment were small and of local character. In general, at that time, Central Poland was a transit area between well-settled loess hills of southern Poland and Kujawy region (e.g. Nalepka 2008, Nowaczyk 2008, Nowak 2009).

The first traces of significant changes in the natural environment related to deforestation and agricultural activity should be connected only with the Bronze Age (the Trzciniec and Lusatian cultures). At the bottom of the Pisia river Valley near Żyrardów, the author recognized the peat deposits, whose top was covered with a rhythmite of mineral and organic-mineral sediments. Peat deposits that were *in situ* material were dated by radiocarbon method at 2830 ± 80 BP and organic and mineral sediments originating from the soil erosion above at 3450 ± 90 BP and 3550 ± 90 BP respectively (Szwarczewski 2003 [1]). The inversion of radiocarbon dates in the described profile indicates the supply of material originating from the erosion of the plateau and slopes, which began to be used agriculturally. Similar observations are made by researchers in the Łódź region, where the first clear phase of anthropogenic transformations of the natural environment is also connected with the Bronze Age (e.g. Twardy 2008, Twardy i in. 2018).

From the beginning of the Iron Age (especially the Przeworsk culture) in the Mazovian region, the reactions of the natural environment to anthropopressure have a more common character and are characterized by greater intensity.

At that time, deforestation and development of agricultural economy on the morainic plateaus resulted in linear erosion in the area of the Ursynów escarpment dated 2100±90 BP and 1980±160 BP (Szwarczewski 2007 [3]) and cutting the slopes of the Skrwa River valley (1790±200 BP), filling with mineral-organic sediments of oxbow lakes (1680 ± 80 BP) and aggradations of its bottom (1810±70 BP) (Szwarczewski, Smolska 2013 [8], Smolska, Szwarczewski 2014 [9]).

Since the early Middle Ages, acceleration of erosion processes caused by the increasing share of agricultural areas has been observed in all discussed areas. Ursynów escarpment (Skarpa ursynowska) is cut by numerous gullies ending with alluvial-deluvial fans (1050±100 BP, 1095±200 BP, 1420±230 BP, 1040±200 BP) and sediments from sheet erosion (730±70 BP) are accumulated at its base) (Szwarczewski 2007 [3]). Land use changes related to the development of medieval settlements also lead to sedimentation of overbank deposits in the Świder river valley bottom, which dates back to 1410±200 BP and 810±80 BP (Szwarczewski 2009 [6]).

The development of mill ponds in the neighbourhood of the early mediaeval settlement in Nasielsk causes filling of the Nasielna valley with organic or organic and mineral deposits. Total thickness of mud sediments deposited, from the early Middle Ages, in the basins of formerly functioning here mill ponds, exceeds 150 cm. The research allowed me to reconstruct the main phases of river valley evolution under anthropogenic conditions and to reconstruct the early medieval morphometric conditions. At present, the top of stronghold rampart is located about 2 m above today's bottom of the valley. In the early

Middle Ages, the height difference had to be 1.5 m higher so it was at least 3.5 m (Błoński, Szwarczewski 2008 [4]). The field studies carried out in the valley of Nasielna allowed to reconstruct the 8 main phases of environmental changes from the early Middle Ages and link them with the economic activity of a human being in this area.

From the early Middle Ages there is also very strong anthropopressure in the natural environment of the Płock area - there start to develop proluvial-deluvial fans (820±70 BP) and oxbow lakes are filled with sediments from slope erosion (860±80 BP) (Szwarczewski, Smolska 2013 [8] , Smolska, Szwarczewski 2014 [9]).

Significant transformations in the area of central Mazovia are associated with deforestation and the development of settlements that took place after the transfer of the capital from Krakow to Warsaw. For example, in the Świder river valley the establishment of new settlements resulted in the very fast filling of the oxbow lake with sediments (565±90BP, 550±100 BP, 510±150 BP) and creation of 2-3 m dune dunes dated 640 ± 80 BP and 320 ± 70 BP after the area was deforested and used for agriculture purposes (Szwarczewski 2009 [6]).

All the above-mentioned phases of the transformation of the natural environment were recorded in the geochemical features of deposited sediments. On the basis of the results of radiocarbon dating, facies variability and the calculated sedimentation rates, it was possible to link the content of trace elements in the sediments with the deposition period (Szwarczewski 2003 [1], 2005 [2], 2007 [3], Szwarczewski, Smolska 2013 [8], Smolska , Szwarczewski 2014 [9]). The geochemical record manifests itself more clearly (with larger measured concentrations of the studied elements) in the nearest vicinities of industrial centers where the supply of contaminants was large and the vertical growth of the sediments was relatively slow - e.g. in the area of Żyrardów (Szwarczewski 2003 [1]). In contrast, in the profiles accumulated in the areas of archaeological sites, e.g. early mediaeval settlements in the Skrwa valley (Szwarczewski, Smolska 2013 [8], Smolska, Szwarczewski 2014 [9]), where at the outlet of erosional cuts, the alluvial-deluvial fans were formed and dynamically progressed there was observed the dilution process of contemporary contamination in unpolluted sediments (coming from deep erosion from Plejtocene layers) - concentrations of the studied elements were 10-15 times lower than those in the vicinity of Żyrardów.

On the base of the analysis of facies variability, geochemical features and radiocarbon dating results, I managed to calculate the variability of the depositional processes from the beginning of the Holocene to modern times. Until the early Middle Ages these processes were pf insignificant values, not exceeding 0.2-0.3 mm/year. Acceleration of erosion processes and sediment accumulation is associated with the emergence of Slavs and stabilization of settlement. During the industrial revolution, the sediment deposition rate reached 2-3 mm/year and in the period of agricultural mechanization after World War II it reached 5-6 mm/year (Smolska, Szwarczewski 2014 [9]). Erosion processes and slope reconstruction can also lead to dilution of previously deposited polluted sediments and "zeroing" of the geochemical record as this took place, for example, on the examined slope in Borowiczki near Płock (Szwarczewski 2005 [2]).

Deluwial deposits accumulated at the base of slopes and settlements building cones at the mouth of gullies and steams cutting the Ursynowska Scarp are a perfect geochemical archive of anthropopressure. During the 700-1000 years that have passed since the beginning of accumulation of these sediments, the concentration of lead increased from 2 mg / kg to 38 mg / kg, and cadmium from 0.1 mg / kg to over 1mg / kg, that is respectively 19 and 10 times. (Szwarczewski 2007 [3]). The value of magnetic susceptibility, which is proportional to the heavy metals accumulated in the sediment, is also nearly 10 times higher (Fig. 4 in the work of Król, Szwarczewski 2018 [11]). Such a clear record is the result of the rapid economic development of the city and a large supply of the analyzed elements (coming from various sources) and relatively small areas of the basin of the erosive forms studied. The geochemical record in this case is very fast and gives a clear increase in the content from the bottom to the surface (Figure 5 in the work of Szwarczewski 2007 [3]). Economic human activity in similar catchments associated with erosive forms in the vicinity of Płock does not give a similar record. Due to the mainly agricultural use of these areas since the early Middle Ages, there is a rapid growth and progradation of fans, while the concentrations of such elements as cadmium or lead increase slightly, i.e. 1.5-2 times, and even in homogeneous, surface-related levels associated with rapid deposition, declines in content are observed of examined metals (Figure 5 in Smolska, Szwarczewski 2014 [9]). Because the rate of depositional processes between the beginning of cone formation in the vicinity of Płock increased from 0.2-0.3 mm / year to 2-3 mm / year and then to 5-6 mm / year (10 and 20 fold increase) and the heavy metal content loads are maintained at a similar level or are even halved, with 10-20 times faster deposition processes we have a 10-20 times higher total pollutant load. Differences in the formation of sediments can be neglected because the profiles studied are characterized by lithological variability and the contents of the elements examined are similar in spite of lithological differences (Figure 5 in Smolska, Szwarczewski 2014 [9]). In the surveyed sites in the Skrwa valley, both on the flood plain, in former oxbow lake filling (Szwarczewski, Smolska 2013 [8]) near Krzyżanowo or in previously described fans at the mouth of the gullies, there is a similar situation of the decrease in the content of the analyzed elements despite the increasing total load of pollutants. Greater supply of uncontaminated deposits from erosion gives the effect of dilution of pollution. The content of trace elements in sediments is therefore a very good indicator of anthropopressure but it should be remembered that in the case of areas used for agriculture, with poorly developed industry, the rate of accumulation of sediments and their origin can have a significant impact on the vertical variability of the concentrations of investigated metals.

Despite quite different absolute values of the elements determined in all profiles, where geochemical features were investigated, it was possible to show the relationship between sediment deposition time and the content of selected trace elements (Szwarczewski 2003 [1], 2005 [2], 2007 [3], Szwarczewski, Smolska 2013 [8], Smolska, Szwarczewski 2014 [9]).

Lakelands and morainic plateaus within the range of historical Balts settlement

The record of human economic activity in the natural environment in the areas associated with the Baltic settlement is completely different (fig. 1 - sites 7-8). This area was distinguished due to the different history of the material culture of these areas and relatively long-lasting primitive forms of management. The oldest forms of agricultural activity begin here only in the Iron Age, around 2,500-2,000 years ago (e.g. Okulicz-Kozaryn 1993, Karczewski 2011).

The results of interdisciplinary research carried out in the vicinities of two hillforts: Skomantai (Lithuania) and Skomack Wielki (Masurian Lake District) showed the relationship between the character and geochemical features of sediments filling local depressions or oxbow lakes and the human economic activity in the past. In the area of the Skomantai hillfort, three geochemical phases of human economic activity were identified, related to archaeologically confirmed settlement phases - from the Roman period, the early Middle Ages and modern times. The inversion of radiocarbon dates in BIS-3 drilling performed in the bottom of the oxbow lake - from 1560±280BP (bottom), through 2190±170 BP to 3990±140 BP indicates for redeposition of soil accumulation levels associated with the intensification of erosion processes caused by enlargement of the area used by man (Stančikaitė and in 2013 [7]). Increased contents of such elements as Cd, Pb and Zn are associated with human economic activity in periods of functioning of the hillfort and settlements located nearby. The top layer enrichment is associated with atmospheric deposition in recent decades.

The hollows in the area of the hillfort in Skomack Wielki have a similar history of development. There are two main phases in their evolution recorded in the sediment diversity originating from erosion. These differences in type of sediments are related to the settlement of these areas by the Balts and by early Middle Ages settlers (Smolska, Szwarczewski 2016 [10]). Absolute dating using the radiocarbon method gave two dates confirming these phases of agricultural activity - 2,300±110 BP and 1180±70 BP, respectively. Changes in the content of trace elements correlate with the highlighted lithological levels and the sediment deposition rate. The youngest subsurface layer of sediments is the result of mechanized agricultural activity (the lands in the vicinity of the settlement were owned by the State Agricultural Farm and were used as arable land until the end of the 1980s).

Facial variability, geochemical features of sediments and obtained radiocarbon dating enable for calculating the rate of depositional processes. For the first settlement phase related to the Iron Age, these values were insignificant (below 0.1-0.2 mm/year), in the Roman period of about 0.4-0.95 mm/year and in the early Middle Ages some 0.7-0.8 mm/year. During the period of agricultural mechanization, in the vicinity of Skomack Wielki hilfort the rate of deposition could exceed 4-6 mm/year.

Summary

The presented research results show significant spatial (regional) and temporal differences in the lithological and geochemical record of human activity in sediments. The reactions of individual sedimentary environments are characterized by asynchrony and result mainly from local preferences in settling and use by man of particular areas.

Human economic activity (especially deforestation and development of agriculture and metallurgy) as well as humid climate phases (more frequent occurrence of extreme events) favored the activation of geomorphic processes (slope, fluvial and aeolian). This started already in the Neolithic period in the loess areas of the Wodzisław Humock (where one of the oldest stages of the deluvial deposits accumulation was recorded 5890±100 BP, Szwarczewski 2009 [5]), while was only of local significance in Mazovia. In the area of Mazovia, the first visible reaction of the natural environment on antropopression is connected with the period of the Bronze Age or the Iron Age. In the areas of north-eastern Poland and Lithuania associated with the Baltic settlements (Smolska, Szwarczewski 2016 [10], Stanickaite et al. 2013 [8]), the oldest record of economic activity in the natural environment is connected with the iron age. There are also large differences in the rate of depositional processes in individual areas - the largest is in the areas of loess uplands in Ponidzie region (Wodzisław Hummock) and much smaller in Mazovia, north-eastern Poland and Lithuania.

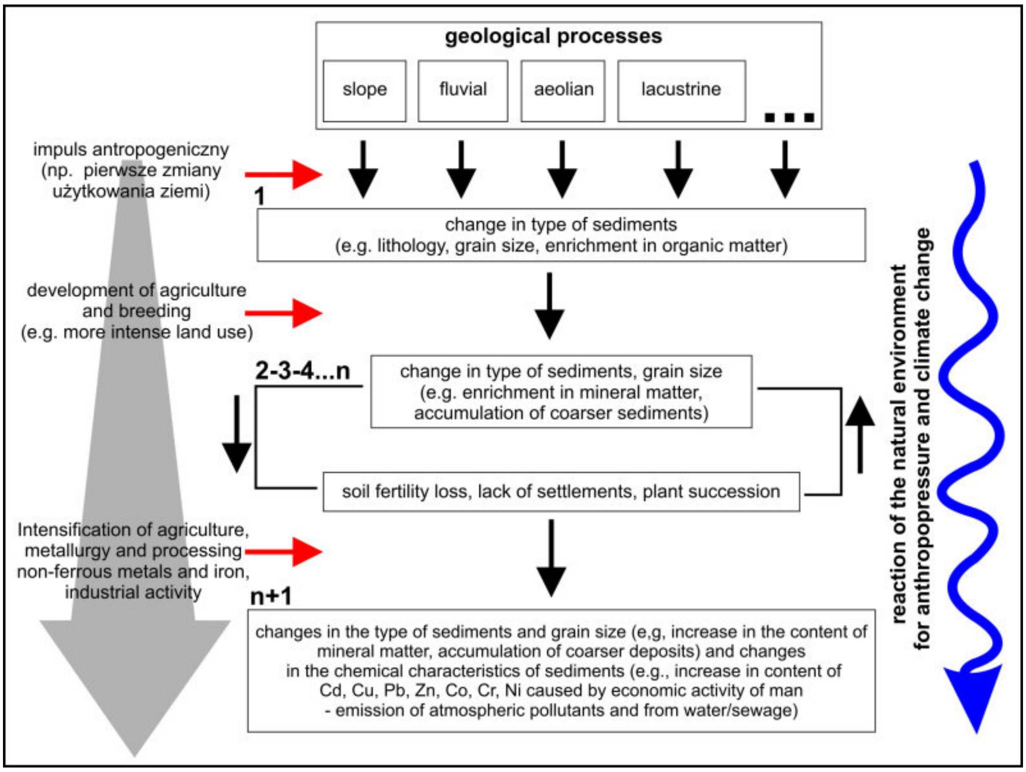

Fig. 4. Model of reaction of the natural environment to anthropopressure.

Distinguished on the basis of structural and textural analysis of sediments, geochemical features and absolute dating, the environmental change phases correlate well with archaeological material available for the studied areas and historical data, which indicates that they are primarily conditioned by human activity. Under favorable climatic conditions, the processes proceeded with increased intensity.

There are also large differences in the rate of depositional processes in particular areas (especially in the first phases of human economic activity). - the largest is in the areas of loess uplands of Ponidzie, much smaller in Mazovia, north-eastern Poland and Lithuania. Their pronounced intensification begins in all areas studied since the Middle Ages. However, the fastest rate of sediment deposition is associated with the period of agricultural mechanization and ranged from 4-6 mm / year in sites located in Mazovia, Mazury and Lithuania, up to 10-20 mm / year in loess areas of southern Poland.

The sediments, geochemical features and absolute dating of the environmental change phase, distinguished on the basis of structural and textural analysis, correlate well with the archaeological material and historical data available for the researched areas, which indicates that they are primarily conditioned by human activity. This means that the main reason for the variability of sedimentation processes in the analyzed period should be considered anthropopressure. However, under favorable climatic conditions, sedimentation processes proceeded with increased intensity. The changes taking place under the influence of anthropopressure in the natural environment can be illustrated by the model and diagrams I have prepared - Fig. 4 and 5.

Antropopression is usually marked in the change of the sedimentation type, but it is not always manifested by higher absolute values of the concentration of trace elements in the sediment (although the tendency to increase content to the surface is prevailing). Sometimes, as a result of local erosion processes, the contaminated sediments may be "diluted" and the geochemical record set to zero (e.g. near Płock, Szwarczewski 2005 [2]) and only the last phase of the record is recorded - in this case it is related mainly to the Mazovian Refining and Petrochemical Works in Płock. If the area covered by deforestation and human activity had a small area then changes related to anthropopressure will be readable only in pollen diagrams.

From Fig. 3 it follows that in all research areas (apart from the areas located in the vicinity of the industrial city of Żyrardów) the ranges of concentrations of analyzed trace elements are comparable. We have, therefore, a similar force of human influence on the natural environment, while the geochemical record of anthropopress manifests itself in various ways. It can be a marked increase in the concentration of heavy metals in the geological profile from the floor to the surface, e.g. the sites in Dobrzyków and Borowiczki near Płock (Szwarczewski 2005 [2]) or cones at the base of the Ursynów Scarp (Szwarczewski 2005 [3ś]. It can also be expressed in poorly marked increase in the content, similar concentrations of heavy metals in the entire profile (almost monotonic) or even (4) a decrease in the concentration of the elements studied towards the surface. The abovementioned possibilities occurred in the studied profiles of sediments from the Skrwa valley, both those constructing fans and accumulated on the flood plain or filling palaeochanels (Szwarczewski, Smolska 2013 [8], Smolska, Szwarczewski 2014 [9]). The geochemical features of the sediments allow for the division of macroscopically and texturally homogeneous or little differentiated sediments (eg loess, agricultural diamectrons) into layers corresponding to various forms of human economic activity in the past.

In the case of testing the content of trace elements and their relationship to human economic activity in the past, not only the absolute content of elements such as Cd, Cu, Pb or Zn is important but especially their vertical variability. In parallel with the supply of trace elements to the natural environment, we are dealing with erosive changes that favor the supply of both material from the surface (in the case of sheet erosion processes) and from incision to the deeper older, unpolluted levels (rill erosion) what causes the dilution of pollution.

Despite the large diversity in the history of settlement and economic development of the areas characterized, the analysis of lithological and geochemical variability proved to be very helpful in identifying the past phases of economic activity of a human being (fig. 5). This type of research is of great application importance: it allows to reconstruct landscape changes that took place under the influence of anthropopression in prehistory and historical times (e.g. Błoński, Szwarczewski 2008 [4]) and may point to potential areas of new archaeological research. These could be for example local depressions and valleys filled with deluvial deposits on the areas built of loess.

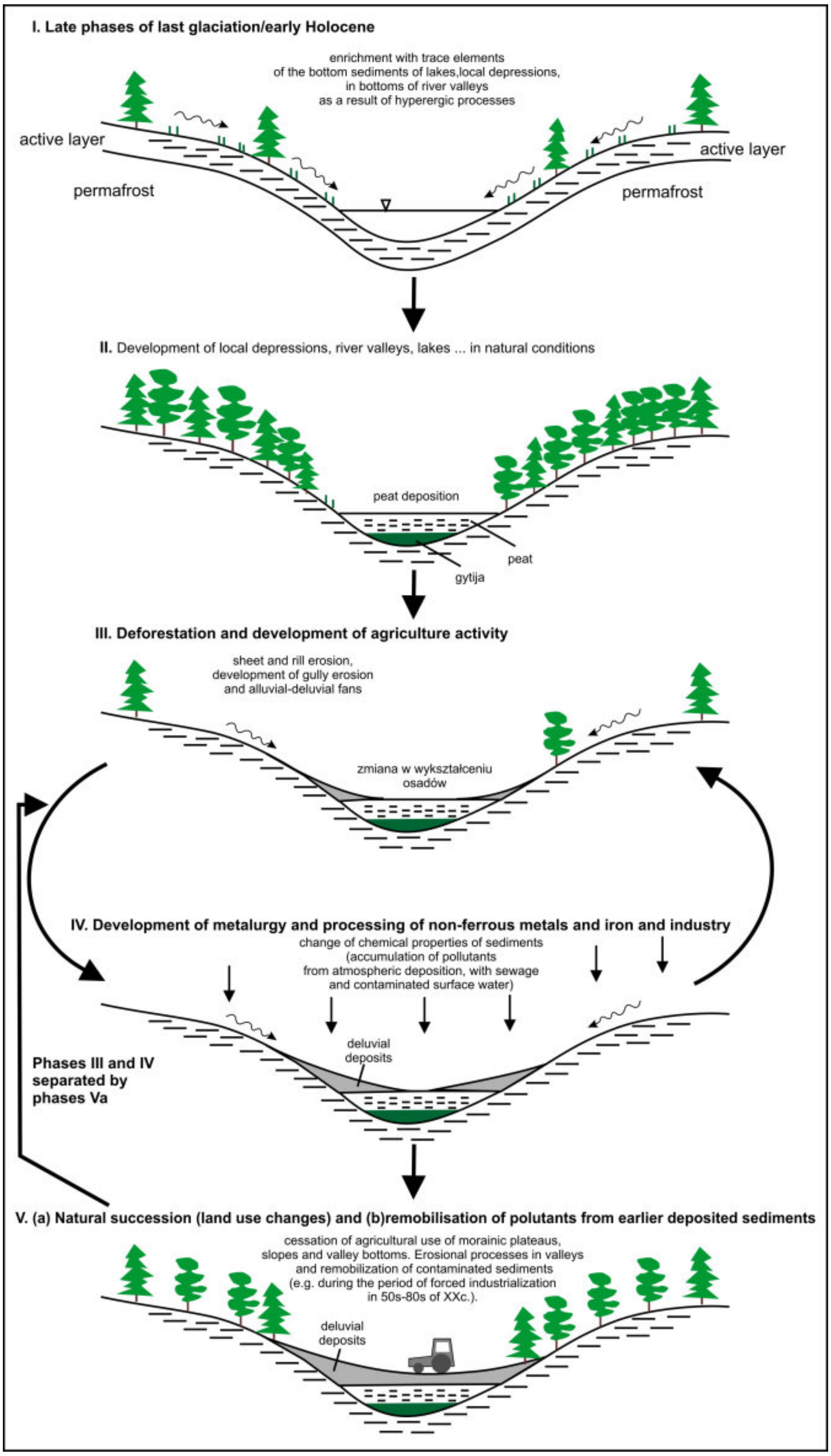

Fig. 5. Phases of transformations of the natural environment in the conditions of increasing anthropopression (a case study of local depression).

To sum up, the most important of my scientific achievements include:

1. Recognition of some of the oldest deluvies in the area of the Hump of Wodzisław, dated to 5,890 ± 100 BP and related to the development of neolithic settlement of the culture of ribbon-cut pottery.
2. Recognizing the main phases of prehistoric and historical anthropopression recorded in lithological and geochemical features of fluvial and slope sediments in Mazovia and north-eastern Poland.
3. Application of interdisciplinary research to distinguish lithological and geochemical phases of human economic activity. This is information that greatly enriches palynological and archaeological data. It also gives the opportunity to obtain more complete information about periods of prehistoric and historical settlement.
4. Relation of the absolute content of heavy metals in sediments with the total load of pollutants supplied and the pace of geomorphological processes. Deposition of sludge from erosion of uncontaminated levels leads to a reduction of heavy metals (dilution of pollutants)
5. Demonstration of spatial and temporal differentiation of the deposit processes. It is the result of the insecurity of settling and diversifying the level of economic development.
6. Demonstrating that geochemical features give the possibility of dividing macroscopically and texturally homogeneous or little differentiated sediments (eg loess, agricultural diamiktones, deluvium) into layers corresponding to different forms of human economic activity in the past.

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5. Other scientific achievements

A full list of published scientific papers or creative professional work as well as information on didactic achievements, scientific cooperation and popularization of science can be found in Attachment 6.

My research interests, for almost 25 years, focus on issues related to the records of human activity in the natural environment. This is largely related to the series of articles included in the scientific achievement. I was one of the initiators and organizers of cyclical conferences/field workshops entitled *Record of human activity in the natural environment*, which were organized in various places in Poland since 2002 (Łomża 2002, Warsaw 2004, Sejny-Suwałki 2007, Białowieża 2010). I actively participated (giving speeches or presenting posters) also in the workshops organized under this formula by other scientific centers (in 2003 in Rudy Wielkie and in 2009 in Kórnik).

A significant part of my scientific activity includes research in cooperation with archaeologists, which I conducted in areas with diversified geology and geomorphology, in Poland and Lithuania. The aim of these studies was to present environmental conditions of the location and development of prehistoric settlements, or reconstruction of environmental changes in the prehistoric period and historical times. These studies, very often interdisciplinary, were carried out in the vicinity of the following archaeological sites/towns:

1. Mozgawa (Moskal del-Hoyo 2018),
2. Stryczowice (Szwarczewski 2013b),
3. Radom (Szwarczewski i in. 2010, Woronko i in. 2011, Szwarczewski 2013),
4. Nasielsk (Błoński, Szwarczewski 2007, 2008a,b,c, Bińka i in 2013),
4. Poganowo (Szal i in. 2013-2015),
5. Bezławeki (Smolska, Szwarczewski 2013),
5. Skomack Wielki (Smolska, Szwarczewski 2016),
7. Urdomin/Rudamina, Lithuania (Szwarczewski i in. 2009),
8. Skomantai, Lithuania (Bliujienė 2012, Stancikaite 2013).
9. The study in the form of a manuscript was also created for Barczewko (see Attachment 6).

The problem of environmental conditions of prehistoric settlements was also undertaken as part of geomorphological research carried out at archaeological sites located along the A2 motorway. These surveys were led by M. Dąbski and also participated by B. Woronko and D. Giriat (unpublished materials listed in Attachment 6).

The results of research carried out in Nasielsk and Radom in the vicinity of early mediaeval settlements, allowed me to reconstruct the main phases of the evolution of the natural environment of the studied sections of river valleys, and present them on schematic cross-sections. For Nasielsk, eight phases of evolution were distinguished, and four phases for Radom (Błoński, Szwarczewski 2008a, Szwarczewski 2013).

My other scientific and research achievements can be divided into the following thematic blocks:

5.1. Geomorphological conditions for the accumulation of heavy metals in alluvial sediments

The problem of heavy metals accumulation in the Vistula alluvial sediments (on the Mazowieckie voivodeship section) was in my doctoral thesis, defended in 1999 (Szwarczewski 1997, 2000). I also conducted similar research myself or in research teams on other rivers, eg Bzura (Sokołowska, Szwarczewski 1998), Nida (Tsermegas et al., 2000), Mała Panew (Ciszewski and others 2003a, b, 2004), Utrata (Szwarczewski 2003b, Biro et al 2014), Świdrze (Łokas et al. 2006), Pilica (Szwarczewski, Korabiewski 2003), Wisła (Smolska, Szwarczewski 2005, Szmańda and others 2018). The content of heavy metals in river sediments depends on from grain size (clay-clayey fraction content), organic matter content, pH, redox as well as time and deposit conditions (Biro et al 2014). As results from my research, the highest contents of trace elements occur in alluvial deposits accumulated in periods related to human industrial activity (e.g. industrial revolution and forced industrialization after World War II) and are recorded in sections of rivers located below large industrial centers (Sokołowska, Szwarczewski 1998, Smolska, Szwarczewski 2005, Szwarczewski 2000, Szmańda and others 2018). The geomorphological conditions are of significant importance in the spatial and vertical differentiation of the concentration of trace elements within the valley bottom, e.g. (1) lateral trunk migration and the increase of contaminated sediments (Szwarczewski 2000, Ciszewski and others 2003a, b, 2004) are of significant importance in the spatial and vertical differentiation of the concentration of trace elements within the valley bottom, (2) processes of incision on stable channel sections and vertical growth of contaminated sediments (Ciszewski and others 2003a, b, 2004), (3) lateral erosion of the bed and remobilization of previously accumulated contaminated sediments (Sokołowska, Szwarczewski 1998, Ciszewski and others 2003a, b, 2004, Szmańda et al. 2018). The thresholds and dams built in the channels and valley bottoms, which forse the accumulation of contaminated sediments within the riverbed, dam reservoirs or in the mill ponds (Szwarczewski 2000, 2003b, Ciszewski and others 2003a, b, 2004, Sypka and others 2007) have great significance.

5.2. The Holocene evolution of the Mleczna River valley in the vicinity of the Piotrówka early medieval stronghold in Radom

Interdisciplinary palaeogeographic research conducted under my leadership for 5 years (2009-2014) in the Mleczna River valley, in the vicinity of the early medieval Piotrówka stronghold in Radom, allowed to reconstruct the Holocene valley evolution (Szwarczewski et al. 2010, Woronko et al. 2011, Szwarczewski 2013a). From the drillings, sedimentological, geochemical, palynological analyzes, archival topographic analyzes and radiocarbon dating results, it appears that at the beginning of the Holocene the bottom of the valley was over 2 meters lower than today. The development of prehistoric settlements, especially the settlement of the present-day city by the Slavs, the creation of the city and then the stronghold and then the city, led to the activation of erosional processes on the slopes and accumulation of sediments in the valley bottom. Environmental studies in the bottom of the valley were conducted in parallel to archaeological research, which gave the opportunity to date the distinguished lithological levels also on the base of cultural material.

The contemporary landscape of the Mleczna river valley in the vicinity of the Piotrówka sronghold is the result of anthropogenic interactions that took place both in prehistory (Neolithic period and in the Iron Age), and in historical times (mainly during the last thousand years) and to a slight extent in the fluvial activity of the river. Particularly intense changes are related to the creation and functioning of the stronghold and settlement in its vicinity during the early Middle Ages. The increase in the population in the vicinity of Radom favored the transformation of the environment. Deforestation and transforming further forest areas for cultivation, influenced the intensification of erosional processes on long, uniformly inclined slopes and the increase in the supply of sediments to riverbeds, which in the nineteenth century ceased to cope with such a large amount of material in the riverbed. Significant transformations of the bottom of the Mleczna river valley in the studied section led to the development of milling, damming water in the bottom of the valley and the construction of ponds used for fish farming and tanneries. Landfill waste storage (their total thickness locally exceeded 1 m), household wastes, brick and concrete debris and soil from foundation excavations has led to raising the bottom of the valley by 70-185 cm over the last 200 years, of which over the last 50 years, on average, 50 cm (Szwarczewski et al 2010, Woronko et al. 2011, Szwarczewski 2013a).

5.3. Geomorphological and sedimentological effects of colonization of loess plateaus

The emergence of Neolithic agricultural cultures in loess areas has led to the activation of denudative processes and accumulation of deluvium at the base of the slopes. After settling, these areas were used continuously in agriculture, which favored erosive processes. A few-meter thick deluvial deposits have been recognized both in the Garb Wodzisławski (Szwarczewski 2006a, 2009, Król, Szwarczewski 2018) as well as in the Podkarpackie lagoons in the vicinity of Zarzecza (Szwarczewski and others 2017).

5.4. Textural features of Pleistocene and contemporary sandurs
In 1996, I took part in a monthly expedition to Iceland, where, together with E. Smolska and D. Giriat, we studied outwash fans in the foreground of Fláa and Fall glaciers in SE Iceland. In individual zones of sandurs (proximal, central and distal), the diversity of textural features (shape, roundness and orientation) of accumulated sediments was examined. The examined characteristics reflected local conditions of transport and material deposition. The relationship between the orientation of thick clusters and the flow directions and the possibilities of using this type of analysis for the study of Pleistocene sanders has been demonstrated (Smolska et al., 1998, Angiel et al. 2005).

Similar studies were carried out on the relatively poorly recognized Olecko-Rajgród outwash. The lithofacious of sediments, distinguished in exposures, indicate the accumulation of sediments by the braided river. On the basis of the differences in the characteristics of sediments constructing the outwash (composition of the gravel fraction and their roundness), the stages of development, related to, among others, with changes in the distance of the accumulation area from the active ice sheet and the length of material transport in a dynamic glacifluvial environment (Krzywicki et al., 2007).

5.5. The natural environment and geography of tourism in selected areas of Poland (around Sejny, Kuźnica and Zarzecze)
The effect of the collected material during the field works, conducted together with Maciej Dąbski, are papers characterizing the natural environment and its evolution as well as tourism geography of three different regions in Poland - Sejny area (Bajkiewicz-Grabowska 2006, Dąbski, Szwarczewski 2006a, b, Szwarczewski 2006b, 2007a, Szwarczewski, Dąbski 2007, Szwarczewski, Kupryjanowicz 2006), Kuźnica region (Dąbski, Szwarczewski 2011, Szwarczewski and others 2011) and Zarzecze environs (Szwarczewski and others 2017). The cited publications present the diversity of the main elements of the natural environment and its evolution both in natural conditions and under the influence of anthropopressure. The works also include the characteristics of tourist values in the vicinity of Sejny (Dąbski, Szwarczewski 2006) and Zarzecze (Szwarczewski and others 2017).

In addition to the issues presented in the topic blocks in my research, I also undertook other problems, most often related to the use of selected research methods for paleoenvironmental reconstructions. Most of these studies are continued, and the results are being developed.

5.6. Evaluation of sediment deposition rate in the oxbow lakes of the Vistula River in the area of Mazovia.
Since 2017 I have been conducting lithological and geochemical studies of sediments filling the oxbow lake of the Vistula within Mazowieckie Voivodship. In the winter of 2017, I collected sediment cores from several oxbow lakes near Kozienice (Szwarczewski and others 2017) and Góra Kalwaria. The diversity of physicochemical and sedimentological characteristics of sediments is the result of local and regional environmental changes that took place in the past (neoholocene). The increase in the sedimentation rate in these reservoirs over the last 200 years should be associated with deforestation, increased supply of sediments from slope erosion and more frequent freshets.

5.7. Evaluation of the sediment deposition rate in the Curonian Lagoon based on interdisciplinary studies
Since 2017, I have been conducting research in cooperation with Lithuanian scientists on the contemporary evolution of the Curonian Lagoon. In the 2017 and 2018 seasons, 8 cores of bottom sediments were collected from the Lithuanian part of the reservoir. Samples of

sediments from one core were thoroughly analysed - the vertical variability of Cs^{137}, Pb^{210} isotopes was determined, radiocarbon dating was performed. An article is prepared for the journal from the JCR list. Preliminary results on the variability of the sedimentation rate were presented at the conference in 2018 (Mazeika et al 2018).

5.8. I also conducted research on Holocene evolution of depressions with no outflow and lakes of north-eastern Poland (Szwarczewski 2007b, 2008b, Szwarczewski, Kupryjanowicz 2008, Smolska, Szwarczewski 2012, Szal and others 2013-2015), and high-altitude Pamir lakes (Mętrak and others 2019) and the pace of modern sediment accumulation in lakes of Poland and Lithuania (Mikalauskienė and others 2015, 2018). The research focused on the type of sedimentation and its Holocene changes, the geochemical record of human activity and the rate of sedimentation.
Studies of the bottom sediments of the Rangkul lake in Pamir showed a relationship between the development of sediments and climate change and the economic activity of human beings. Cyclic changes in the range of the lake and its depth were recorded in lithological variability. Based on the results of radiocarbon dating of bottom sediments of the lake and modern vegetation, a depth age model was built, which shows that reservoir effect for this lake exceeds 2000 years.

5.9. The use of the dendrochronological method in dating erosive processes in the valley of the unnamed tributary of the Świder River in Mazovia. Measurements of annual tree rings allowed for the dating of river erosion processes and linking it to the historically documented reconstruction of the road and regulatory works in the river bed (Szwarczewski 2008a).

5.10. In recent years, together with employees of the State School of Higher Education in Biała Podlaska, we conduct research on anthropogenic conditions of erosion and development of slope covers in the vicinity of Neple by the Bug river. Initial research results were presented at 2 conferences (Szwarczewski et al. 2017, Zbucki et al. 2018). The erosive forms we study are very young forms. This is due to the relatively late colonization of these areas with permanent settlements. The geochemical analyzes of sediments that build alluvial-deluvial cones have demonstrated the relationship between the age of sediments and the economic development of the surrounding areas over the last several hundred years.

5.11. Bibliometric indicators and statistics of publications
(detailed list in Annex 6, points II F-H)
I am the author or co-author:

- 37 papers (12 in English) published in scientific journals (5 before obtaining a PhD degree), of which 8 were published in journals from the Journal Citation Report (JCR), with IF and 29 publications in journals without IF,
- 3 works in English (chapters in a scientific monograph or conference materials) located in the JCR database but not having IF (indexed in the Web of Science database),
- 25 works published in monographs (2 before obtaining a doctoral degree), of which 2 in English, and
- 67 conference notes (of which 30 in English).

The total Impact Factor of my publications according to the JCR list is IF = 12,289, 5year IF = 13,562; the sum of points according to the MNiSW list is 453. The number of publications citation is: according to the Web of Science database (WoS): 31 (without self-citations 29, includes 11 of my publications); according to the Scopus database: 44 (includes 19 of my publications); according to the Google Scholar database: 128 (includes 71 of my publications); according to Publish or Parish database: 153 (includes 69 of my publications). The Hirsch index is: according to the Web of Science database (WoS): h = 3, according to Scopus database: h = 4, according to Google Scholar database: h = 6, according to Publish or Parish database: h = 6.

5.12. Participation in research projects (full list in Attachment 6, point II
I was the manager of two research projects and contractor or main contractor in 9 other MNiSW. These projects concerned geomorphological, geochemical, palaeogeographic, geoarcheological and widely understood anthropopression records in the natural environment.

I also directed palaeoenvironmental research in the Mleczna River valley in the vicinity of the early medieval Piotrówka stronghold in Radom (Szwarczewski et al. 2010, Woronko et al. 2011, Szwarczewski 2013), I participated in geoarcheological surveys funded by the Research Council of Lithuania near the Skomantai stronghold in Lithuania (Stancikaite 2013) and I was a contractor of palaeogeographic research in Barczewko near Olsztyn as part of the Polish-German project Barczewko - Warmian Pompeii. I also took part in geological and geomorphological research of archaeological sites on the A2 motorway route (on the Mazowsze section, Konotopa-Wiskitki node) and in monitoring the natural effects of the agro-environmental program (commissioned by the Ministry of Agriculture and Rural Development).

5.13. Prizes and awards
I received **2 awards** from the Rector of the University of Warsaw for outstanding doctoral thesis - November 16, 1999 and 3rd degree Individual for effective scientific activity, and especially for research and expertise allowing to expand geography fields of interest to other science - October 10, 2017 and **2 awards** of the Dean of the Faculty of Geography and Regional Studies of the University of Warsaw on the occasion of the Warsaw University Day: for exceptional scientific activity - November 2009 and for outstanding scientific achievements - November 18, 2011.

5.14. Scientific internships and study visits
In the years 1992-1993, I held a one-year scholarship under the Tempus program at the University of Greenwich, School of Earth Sciences in London. As part of the Erasmus program I conducted field clworks and lectures on geomorphology and paleogeography at the Charles University in Prague (2010), the Commenius University in Bratislava (in 2011, 2012, 2017, 2018), Vilnius University in Vilnius (in 2014, 2015, 2016, 2017, 2018, 2019).

5.15. Conferences
I presented the results of my research as papers, posters or sites during field sessions. At 24 international conferences, I presented 17 papers and 10 posters, a further 14 papers / posters were presented by the co-authors. At 25 national conferences, I presented 27 papers and 12 posters, and another three papers / poster were presented by a co-author.
I was the organizer of 6 national conferences / workshops and one session at an international conference (for details see Attachment 6, IIIC)

5.16. Reviews
I made 6 reviews of scientific articles: 3 for journals from the JCR list (Radiocarbon, The Holocene, Polish Journal of Environmental Studies) and 3 for journals from the B list (Polish Journal of Soil Science, Acta Geographica Lodzensia, Miscellanea Geographica)

5.17. Didactic activity

During the work in the Faculty of Geography and Regional Studies of the University of Warsaw, I taught undergraduate and graduate studies (day, evening and extramural) at the Geography and Spatial Management and at the Interfaculty Studies of Environmental Protection. In the years 1995-2019 I conducted classes in 20 different subjects (lectures and exercises) in Polish and English. A full list of subjects is provided in Attachment 6.

I created a new field work formula (*Field study methods*) for evening and extramural students covering joint training on geological and topographic issues.

I have also prepared a new formulas of the Physical Geography Training course, where during the 6-day field trip students of the first year of the geography course acquire basic knowledge about the methods of research applied in physical geography and cartography/topography. I have been the head of these classes since 2012; Field exercises take place in the area of the post-glacial area near Olecko.
I am also the manager of the *Geology extension classes*, which are field trips and take place in the Świętokrzyskie Mountains, near Chęciny.
While working at the Faculty, I was the supervisor of 21 MSc theses and 7 BSc theses. A significant part of the works I managed had a significant share of field and laboratory research (drilling, sedimentological and physicochemical analyzes).
My didactic activity is highly rated, which is confirmed by the results of class evaluation surveys carried out among students.

5.18. Other activities
I am a member of the Association of Polish Geomorphologists (since 1999) and the Association of Environmental Archeology (since 2007).
I was the editor/co-editor of 5 books and 2 thematic issues of Geographical Works (Attachment 6, IIIG).

I am the co-author of Protection Plans (Operators of Abiotic and Soil Protection) of two landscape parks: Chęcińsko-Kielecki Landscape Park, Kozubowski Landscape Park and one national park - Wigry National Park (Szwarczewski, Smolska 2009, Smolska, Szwarczewski 2014, Suchożebrski, Szwarczewski 2019).

As part of international cooperation, I conducted research in the area of southern Slovakia, near Bratislava and Nitra, Kunov-Senica, Ivanke pri Nitre (Smetana, Szwarczewski 2015, Smetanova and others 2016) as well as Lithuania - around Klaipeda, Skomantai stronghold, Polish-Lithuanian borderland, around Vilnius (Szwarczewski and in 2009, Stancikaite et al. 2013, Mazeika and others 2018). International cooperation also allowed for detailed geochemical research in the Utrata river valley (Mazowsze), which resulted in the publication in the journal from the JCR list (Biro et al., 2014).

I also provided scientific supervision over a Slovak PhD student from the Commenius University in Bratislava during his schlarship at the Faculty of Geography and Regional Studies (2011).

I took an active part in the organization of the faculty laboratory - including in the selection and purchase of analytical equipment (including geological samplers and probes, increment borers, microscopes, software).

I also helped with the organization of an exercise laboratory for the *Basics of geology*.

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