Soil pollution with heavy metals from the mass graves from I and II World War in Poland. Looking for solution

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Abstract The article presents the problem of soil pollution with heavy metals from corrosive metal elements of military equipment in Poland. The issue concern mass graves from I and II World War on south part of Poland. The influence of mass graves on the environment is poorly investigated. Some of the mass graves are still unknown and non-localized.

The research shows the significant role of heavy metals (eg. Cd, Cr, Cu, Ni, Zn) released into the soil and groundwater, which endanger human health and natural environment. Mass graves are dangerous for us, because many of them are located near to human settlements and rivers. Systematically, chemical elements pass into the soil from metal weapons, buttons, badges, and more. By this, the soil and groundwater is several times higher saturated of heavy metals than from communal waste.

The aim of this paper is to propose one of the solutions, possible to reduce this problem. The authors propose testing archaeological research of mass graves with the metal detector (type VLF, with distinction between different types of metals), in order to locate, safeguard and transmit for the conservation and display in a local museum.

Keywords: heavy metals, pollution, metal detector, archaeology

1. Introduction

The impact of the mass graves which remained after World War I and World War II and continues to have a negative effect on the environment and on humans, is the theme ignored by the scholars in Poland.Limited studies on the impact of the aquatic environment of chemical compounds and elements from the cemeteries are carried out mainly in Brazil, Australia, the USA, Great Britain and Poland (Żychowski and Lach, 2005). It confirmed that the close proximity to the burials concentrated on small area has negative influence on the environment and can be dangerous to human health through increased content of some chemical elements in the soil and ground water.With the establishment of cemeteries is clearly defined depth at which can be buried coffin, as well as the distance from the groundwater and watercourses. In the case of the mass graves, their location is not just accidental, but also often conducive to the spread of heavy metals (Cd, Cr, Cu, Ni, Zn) and other chemicals (amino acids, cadaverous poison, ions, manganate). Type of soil, ground water depth, distance from watercourses and the degree of forestation have a big impact on the rate at which heavy metals get into the soil and water.

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Not all of the mass graves from period of World War I (1914-1918) and World War II (1939-1945) have been found and exhumed.The main part of the unknown mass graves constitutes burials in the east part of Poland. Even after decades, heavy metals from corroded bullets, knives, badges, buttons, and other similar items are still being released into nature, and are harmful to human health.This is the reason why the mass graves should be found and exhumed. The metal elements could be safeguard and transmit for the conservation and display in a local museum.

Currently, the Commission for the Prosecution of Crimes against the Polish Nation in Warsaw carries out investigations to find mass graves, but many cases are discarded because of insufficient evidence and no direct witnesses of the murders. Important dubious evidence is confusing testimonies of people. Investigations there were not made immediately after the incident, and therefore the memory of the details is fuzzy or complemented by what witnesses they heard from others at a later time. False memories bind also to the location of mass graves.

This paper proposes the use of a metal detector, type VLF, which distinguishes between different types of metal, for easier and less expensive than the excavations location of mass graves.

2. Materials and methods

2.1. The effect of heavy metals

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Table 1. Requirements for drinking water by the Minister of Health dated 19 November 2002 year, mg/dm³.

Metal	Allowable concentration
Cd	< 0,003
Cu	< 2,0
Cr	< 0,05
Ni	<0,02

Pollution of heavy metals is extremely dangerous, because they can get into the food chain. Results of poisoning are not immediately visible. They may become noticeable after several years or even generations. Factories dealing with metalworking try their best to protect the entry of pollutants into the environment (Romanowska- Duda, 2015). The degree of pollution and impact on live organisms depend mainly on the type of element, chemical form, as well as the physical condition of the organism (Kabata-Pendias, Pendias, 1999). The pollution of the water with chemical elements is especially important, because water is the basic transport unit of all chemical elements, including heavy metals.The concentration of heavy metals in the water depends on their physic-chemical properties such as pH, occurring contaminants and redox properties.

Toxic concentration of zinc and cadmium for plants, aquatic microorganisms and fish starts from 0.1 mg / dm³.Poisoning in plants is manifested growth retardation, leaf diseases, the impact on the process of transpiration and photosynthesis limitationAcceptable concentration of cadmium in water is 0.003 mg / dm³.From 0.3 mg / dm³ water is poisonous to fish, and 4 ppm starts to poison plants. In humans, cadmium intoxication revealed renal failure, liver, intestine, anemia, hypertension, changes in the cardiovascular system, bone decalcification and carcinogenicity.

Copper poisoning causes large changes in the blood chemistry.

Zinc is readily soluble, its concentration in natural water is 0.01 mg / dm³. The ground drinking water standards is the concentration ranges from 0.015 mg / dm³ to 0.08 mg / l. Zinc-toxic concentrations begin from 0.24 mg /dm³, and the allowable zinc content of the discharged waste water is 2 mg / dm³(Romanowska-Duda, 2015).

Chromium has a low solubility, usually settles in the water and on land. Chromium, however, creates dangerous chromium compounds, which are easier to dissolve in water and highly penetrate the soil and ground water. Too high concentration of chromium causes DNA damage, lipid peroxidation and cell death. A safe daily dose of chromium for humans is from 50 to 200 mg.

Acceptable concentration of nickel in drinking water is very low – 0,02 mg / dm³. At elevated concentrations has a negative impact on live organisms, can cause allergies (Cieśla, Michniewska, 2013).

2.2. Heavy metals and mass graves

Research conducted by Żychowski in an environment of mass graves from World War I and World War II showed that are characterized by several times higher increase in the concentrations of heavy metals in the area of the mass grave.One of the studies focused on the mass grave of 700 people, located in the PuszczaNiepolomice, near Niepołomice(fig.1). The execution of the victims took place on 2 August 1942. The site is located on the Pleistocene terrace of the Vistula River, at an altitude of 205 m above sea level near the dunes. The victims were buried shallowly in the sands of terraces accumulation up to 1 meter. The water level is slightly lower than the grave. Environmental conditions definitely are conducive to migration of chemical elements.Chemicals were evident in the shape of the substrate in the form of discoloration solid. The samples for testing were taken from the substrate of grave and onecontrol sample was taken from the distance of 200 m from a mass grave (Żychowski, 2009).

Figure 1. The location of mass graves, Niepołomice

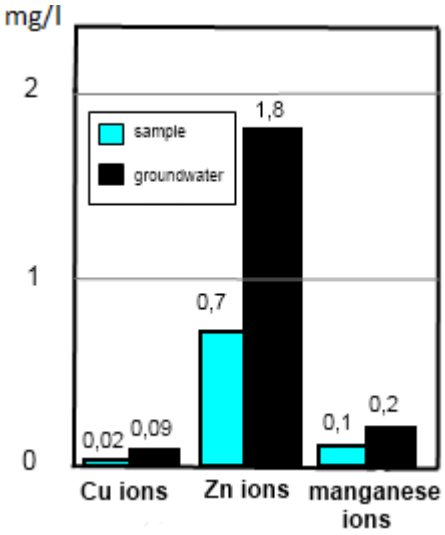

Figure 2. Ions in groundwater under a massive grave, 2004 year, Niepołomice

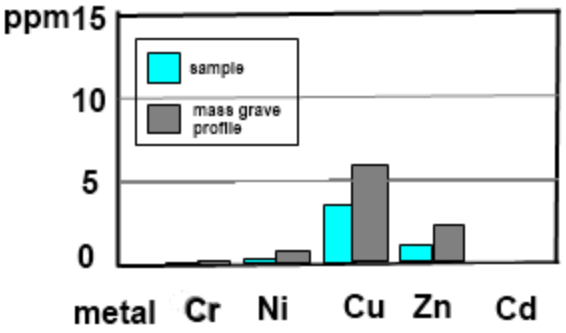

Figure 3. Content of chemical elements in the profiles of mass graves and from a sample place of the same environment, Niepołomice

The collected samples from the mass grave were shown three times higher concentration of nickel, twice the concentration copper and zinc (fig.2, fig.3).The concentration of cadmium was similar to the control sample - from 0.1 to 3 ppm. The concentration of copper ranged between 2 and 16 ppm, nickel, from 1 to 3 ppm of zinc 4 to 8 ppm (Żychowski, 2007). Żychowski's further research showed that the most dangerous concentration of heavy metals is present in the area of the mass grave at Auschwitz. The victims were buried in full uniform, with buttons and medals. They possessed with a metal object, such as a gun or knife. Besides, in the bodies of the victims were bullets or metal fragments. Similarly dangerous to human health heavy metal concentrations were also found in mass graves in Zbylitowska Mount near Tarnow, Bachkovo near Bochnia from World War II and in New Zmigrod, in NowySacz, Mikluszowice, in Krosno and Rakowice - the World War I. Significant increase of chromium were found in a mass grave from World War II

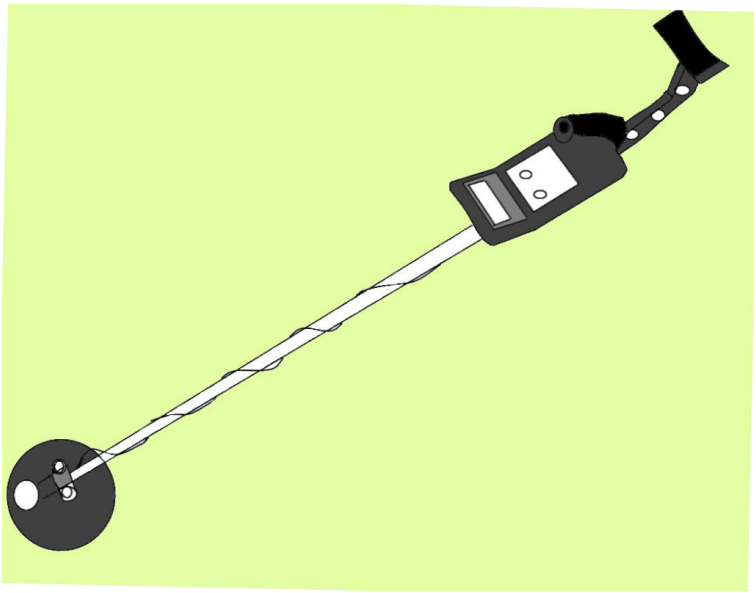

Figure 4. Metal detector, model VLF

in Dukla, and zinc - in a mass grave from World War I in Rajbrot (Żychowski, 2008).

The study showed how important for balance of the environment and for the maintenance of human health is to locate previously undiscovered mass graves.

2.3. Proposed solution

The information collected from documents and relations of people is showing possible territory of the hidden mass graves. These areas are big and difficult to check it with traditional archaeological research method like a trial trench. It is also impossible to use aerial photos, because studied fields in the main part are inside the forest or on the bushy hills.The Commission for the Prosecution of Crimes against the Polish Nation in Warsaw, which is conducting contemporary investigations, need to have clear directions about place of inhumation.

The solution could take advantage of the use of a metal detector (VLF model which after appropriate setting detects a specific kind of metal) in research exploration of the mass graves of World War I and World War II (Fig.4). With this way bigger area can be checked by a small group of people, walking alongside marked straight paths. What is important, wooded territory is free of devices interfering with the work of detector, such as power lines.The metal detector operates by the generation of the magnetic field penetrating the ground. The coil detector receives the electromagnetic waves produced by metal objects and indicates finding the object through sound.

3. Results

The problem of environmental pollution with heavy metals is a serious problem threatening the health and human life. The impact of the mass graves is especially visible on the example of the concentration of harmful chemicals on groundwater. Studies have demonstrated that the concentration of heavy metals in the environment closes to the mass graves of the World War I and II are often several times higher than outside the contaminated area. Therefore, it is important to find other war mass graves, exhumation and relocation of human remains. Research using a metal detector could significantly improve, speed up and reduce the cost of work on the location of the graves.

4. Conclusions

Mass graves are dangerous for human health. Their location is not accidental, but often conducive to the spread of heavy metals (close to rivers and areas used by people, buried shallow underground). Locating of unknown graves is very important for the past by the giving identity to the victims, for the present - to inform living family members and removing health threats, and also for the future - commemoration of the victims and to prevent another tragic conflict.

References

Cieśla P. and Michniewska A. (2013), *Wpływ wybranych związków chemicznych na organizmy żywe*, Uniwersytet Pedagogiczny, Instytut Biologii Zakład Chemii i Dydaktyki Chemii Kraków.

Rozporządzenie Ministra Zdrowia z dnia 19 listopada 2002 r. w sprawie wymagań dotyczących jakości wody przeznaczonej do spożycia przez ludzi (2002). *Dziennik Ustaw*.

Greinert A. (2008), Normy zawartości metali ciężkich w glebach w Polsce i UE w kontekście ich mobilności w warunkach presji urbanistycznej,*Ekotoksykologia w ochronie środowiska*, B. Kołwzan, K. Grabas, 121-128.

Kabata-Pendias A. and Pendias H. (1999), *Biogeochemia pierwiastków śladowych*, Wydawnictwo Naukowe PWN, Warszawa.

Romanowska-Duda Z. (2015), *Metale ciężkie jako specyficzne zanieczyszczenia środowiska wodnego*, Centrum Badań i Innowacji Pro-Akademia, Baza Wiedzy.

Żychowski J. (2006), The effect of mass grave on the content of selected organic compounds in groundwater, *Stan i antropogeniczne zmiany jakości wód w Polsce***IV**, Ziułkiewicz M., Wyd. Uniwersytetu Łódzkiego, Łódź.

Żychowski J. (2008), *Wpływ masowych grobów z I i II wojny światowej na środowisko przyrodnicze*, Wydawnictwo Naukowe AP, Kraków.

Żychowski J. (2009), Zawartość pıerwıastków w wybranych elementach środowıska przyrodnıczego otoczenıa masowego grobu położonegow Puszczy Niepołomickiej, *Acta Sci. Pol., Formatio Circumiectus* 8 (3–4), 43-56.

Żychowski J. (2010), Wpływ krakwskich cmentarzy na środowisko przyrodnicze, *Przegląd Geograficzny* 82/3, 409-433.

Żychowski J., Lach J. and Kolber M. (2007), Wpływ podłoża z masowym pochówkiem z II wojny światowej na skład chemiczny wód gruntowych,*Stan i antropogeniczne zmiany jakości wód w Polsce*, **IV**. Red. Ziułkiewicz M., Wyd. Uniwersytetu Łódzkiego, Łódź, 349-359.