

Mineral composition in rhizosphere of plants grown in the vicinity of a Zn-Pb ore flotation tailings pond. Preliminary study

JERZY CABALA^{1*}, EWA TEPER¹, LESLAW TEPER¹, EUGENIUSZ MAŁKOWSKI², ADAM ROSTAŃSKI³,

¹ Faculty of Earth Sciences, University of Silesia, 60 Będzińska St, 41-200 Sosnowiec, Poland

² Faculty of Biology and Environmental Protection, University of Silesia, 28 Jagiellońska St, 40-032 Katowice, Poland

³ Faculty of Biology and Environmental Protection, University of Silesia, 28 Jagiellońska St, 40-032 Katowice, Poland

9 Figs, 2 table.

In this study, mineral forms in rhizosphere and bulk substrate were examined for selected plant species (*Cardaminopsis arenosa*, *Calamagrostis epigeios*, *Deschampsia caespitosa*, *Festuca ovina*, *Silene vulgaris*, *Viola tricolor*), which grow spontaneously in the close vicinity of tailings pond as well as the zone of eolian transmission of waste particles. Samples of substrates and plant roots were taken at sites in the Bolesław orefield near Olkusz. The substrates together with roots of the plants were studied by environmental scanning electron microscopy coupled with energy dispersive spectroscopy. Apart from quartz and carbonates, the most frequent mineral phases found were crystalline and amorphous Fe oxides as well as primary Fe, Zn, and Pb sulphides (marcasite, pyrite, sphalerite, and galena). Hydrated Ca, Mg, and Fe sulphates (gypsum, epsomite, and melanterite), and other secondary minerals (smithsonite, cerussite, otavite and Fe, K, Mg aluminosilicates) were found at larger concentrations in the rhizosphere compared to bulk soil suggesting that plant roots can change mineral composition of soil.

Key words: Flotation tailings pond, mineral components, rhizosphere, bulk soil, hyperaccumulator and nonaccumulator plants.

REFERENCES

- CABALA J. 1996. Concentrations of trace elements in Zn-Pb ores and possibilities of their transfer to waste deposits. *Prace Naukowe Głównego Instytutu Górniczego Seria Konferencje* 13: 17-32 [in Polish].
- CABALA J. 2001. Development of oxidation in Zn-Pb deposits in Olkusz area. In: PIESTRZYŃSKI A ET AL. [eds.], *Mineral deposits at the beginning of the 21st century*, 121-124. Balkema, Lisse.
- CAMPBELL R, AND GREAVES MP. 1990. Anatomy and community structure of the rhizosphere. In: LYNCH JM [ed.], *The rhizosphere*, 11-34. John Wiley & Sons Ltd., Chichester, West Sussex, England.

- COURCHESNE F, AND GOBRAN GR. 1997. Mineralogical variations of bulk and rhizosphere soils from a Norway spruce stand. *Soil Science Society of America Journal* 61: 1245-1249.
- CURIE C, AND BRIAT JF. 2003. Iron transport and signalling in plants. *Annual Review of Plant Biology* 54: 183-206.
- DMOWSKI K, AND BADUREK M. 2002. Thallium contamination of selected plants and fungi in the vicinity of the Bolesław zinc smelter in Bukowno (S. Poland). Preliminary Study. *Acta Biologica Cracoviensia Series Botanica* 44: 57-61.
- GOBRAN GR, CLEGG S, AND COURCHESNE F. 1998. Rhizospheric processes influencing the biogeochemistry of forest ecosystems. *Biogeochemistry* 42: 107-120.
- GOBRAN GR, CLEGG S, AND COURCHESNE F. 1999. The rhizosphere and trace element acquisition in soils. In: SELIM HM, AND ISKANDAR A [ed.], *Fate and transport of heavy metals in the vadose zone*, 225-250. CRC Press, Boca Raton.
- GÓRECKA E, BELLOK A, SOCHA J, WNUK R, AND KIBITLEWSKI S. 1994. Differentiation of metal content in the flotation tailings of Zn-Pb ores (ZGH Bolesław, Olkusz region, SW Poland). *Przegląd Geologiczny* 10: 834-841 [in Polish].
- GRUSZCZYŃSKI S, TRAFAS M, AND ŻULAWSKI C. 1990. Characteristics of soils in the Olkusz region. *Zeszyty Naukowe AGH. Sozologia i Sozotechnika* 32: 113-122 [in Polish].
- HEIJLEN W, MUCHEZ P, AND BANKS DA. 2001. Origin and evolution of high-salinity, Zn-Pb mineralising fluids in the Variscides of Belgium. *Mineralium Deposita* 36: 165-176.
- HITZMAN MW, AND BEATY DW. 1996. The Irish Zn-Pb-(Ba) orefield. *Society of Economic Geology Special Publications* 4: 112-143.
- KABATA-PENDIAS A. 1980. Heavy metals sorption by clay minerals and oxides of iron and manganese. *Mineralogia Polonica* 11, 2: 3-13.
- KUCHA H, AND JĘDRZEJCZYK B. 1995. Primary minerals of mining and metallurgical Zn-Pb dumps at Bukowno, Poland, and their stability during weathering. *Mineralogia Polonica* 26: 75-99.
- KÜPPER H, LOMBI E, ZHAO F, AND MCGRATH SP. 2000. Cellular compartmentation of cadmium and zinc in relation to other elements in the hyperaccumulator *Arabidopsis halleri*. *Planta* 212: 75-84.
- LEACH D, PREMO B, LEWCHUK M, HENRY B, LE GOFF M, ROUWIER H, MACQUAR JC, AND THIBIEOZ J. 2001. Evidence for Mississippi Valley-type lead-zinc mineralization in the Cevennes region, Southern France, during Pyrenees orogeny In: PIETRZYŃSKI A ET AL. [eds.], *Mineral deposits at the beginning of the 21st century*, 157-160. Balkema, Lisse.
- MALKOWSKI E, AND KURTYKA R. 2003. Mechanisms of zinc and cadmium hyperaccumulation in plants. *Advances in Cell Biology* 30: 483-495 [in Polish].
- MARSCHNER H, AND RÖMHELD V. 1996. Root-induced changes in the availability of micronutrients in the rhizosphere. In: WAISEL Y, ESHEL A, AND KAFKAFI U [eds.], *Plant roots, the hidden half*, 557-579. Marcel Dekker, Inc., New York 10016, USA.
- MAYER W, AND SASS-GUSTKIEWICZ M. 1998. Geochemical characterization of sulphide minerals from the Olkusz lead-zinc ore cluster, Upper Silesia (Poland), based on laser ablation data. *Mineralogia Polonica* 29: 87-105.
- MAYER W, SASS-GUSTKIEWICZ M, GÓRALSKI M, SUTLEY S, AND LEACH DL. 2001. Relationship between the oxidation zone of Zn-Pb sulphide ores and soil contamination in the Olkusz ore district (Upper Silesia, Poland). In: PIETRZYŃSKI A ET AL. [eds.], *Mineral deposits at the beginning of the 21st century*, 165-168. Balkema, Lisse.
- READ DB, GREGORY PJ, AND BELL AE. 1999. Physical properties of axenic maize root mucilage. *Plant and Soil* 211: 87-91.
- ROSTAŃSKI A. 1997. Vascular plants in areas contaminated by heavy metals. *Acta Biologica Silesiana* 30: 56-85 [in Polish].
- WIERZBICKA M, AND ROSTAŃSKI A. 2002. Microevolutionary changes in ecotypes of calamine waste heap vegetation near Olkusz, Poland: a review. *Acta Biologica Cracoviensia Series Botanica* 44: 7-19.
- ZHAO FJ, HAMON RE, AND MCLAUGHLIN MJ. 2001. Root exudates of the hyperaccumulator *Thlaspi caerulescens* do not enhance metal mobilization. *New Phytologist* 151: 613-620.
- ŻABIŃSKI W. 1964. Geochemical investigation on the oxidation zone of Silesia-Cracow zinc and lead ore deposits. In: On the mineralization of Triassic formation in Poland. *Prace Geologiczne* 19 [in Polish].