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Done by humans or done by nature? Assessing anthropogenic impact in a former smelting area – a multi-tool approach

Katarzyna Kądziołka (1), Jakub Kierczak (1), Anna Potysz (1), Anna Pietranik (1), Vojtěch Ettler (2), Alice Jarošíková (2), Anna Wojas (3), and Artur Sobczyk (1)

(1) Institute of Geological Sciences, University of Wroclaw, Wrocław, Poland, (2) Institute of Geochemistry, Mineralogy and Mineral Resources, Charles University, Prague, (3) Institute of Geophysics, AGH Science and Technology University, Kraków, Poland

For hundreds of years, numerous environments have been influenced by human activity. Residues of this activity recently associated with the Anthropocene vary depending on the time and place, thus its recognition requires numerous studies for detailed data gathering. In this presentation, we will discuss the scale of human impact in the historical smelting area, in the Old Copper Basin, SW Poland. Copper smelting carried between 300 to 50 years ago caused significant modifications in the natural forest environment. Application of numerous methods, such as cartography, geochemistry (element, isotope, leaching study), geophysics and modelling allowed for recognition of changes caused by the human presence in this area and determining the scale of anthropogenic impact not only in the matter of surface modifications but also subsurface pollution.

Two main types of wastes are present in the studied area: mining (rocks) and smelting (slags) wastes. Following wastes deposition, materials were incorporated into the environment becoming partially invisible on the surface. Detailed geochemical study of rocks, slags and soils enabled identification of the general pollution in the area which is mostly associated with Cu contamination (up to 1500% over the limit) as well as Ni, Co, Ba and As. Leaching study (EDTA extractions, SPLP test, pH-dependent test) confirmed that especially Cu, Fe and Zn are easily extracted into the environment. Elements distributions in the vertical orientation were studied through soil profiles, magnetic susceptibility and GPR analysis. Geophysical methods were implemented as a proxy to intrusive geochemical sampling. Magnetic susceptibility was conducted on a regular grid, parallel to topsoil samples collection. Results presented areas of increased susceptibility related to high concentrations of ferromagnetics, i.e. iron, cobalt and nickel. Considerable fluctuations in apparent magnetic susceptibility (8.4–625.7 κa•10-5 [SI]) on small distances pointed to areas of metals accumulation, not strictly related to waste heaps location. Ground-penetrating radar was used for 2D and pseudo-3D modelling that granted insight into the subsurface, allowing distinguishing depth of wastes occurrence and (with magnetic susceptibility) depth of anthropogenic and geogenic factors in the final chemical composition of soils. Lead isotopes (206Pb, 207Pb, 208Pb) were applied in order to recognize geogenic factors (rocks geochemical imprints) and non-smelting anthropogenic impacts (e.g. gasoline signatures) in the area. For most of the samples, the results follow general Earth's trends with increased values of 208Pb and 206Pb in anthropologically changed material. Interesting patterns are presented by slags, which present almost a whole range of results, allowing suggesting different rock additives in the furnace.

The main outcome of our research was to propose a new methodology for pollution assessment to be applied to archaeological sites. The presented multi-tool approach also allowed us to define the zone of anthropogenic impact in the studied area. This zone is not only restricted to the depth of occurrence of smelting wastes and other artefacts but it goes deeper through modification of soil chemical and physical properties.

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